International Conference on Electronic Materials, Semiconductor Devices and Emerging Technologies (ICEMSET-2026)

(16–18 November, 2026)

Hybrid Conference
https://www.rwconferences.com/icemset2026

Abstract Book

Organized by:
Department of Physics
Guru Jambheshwar University of Science & Technology (GJUST), Hisar, Haryana, India
&
MetaSciTech Society, Rohtak, Haryana, India

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Guru Jambheshwar University of Science & Technology (GJUST), Hisar, established by the Government of Haryana, is one of India's leading state universities, recognized for excellence in teaching, research, innovation, and sustainable development. The University is accredited with an 'A+' Grade by NAAC and has consistently achieved outstanding national and international rankings. In the NIRF 2024, GJUST secured 47th rank among State Public Universities, 55th in Pharmacy, and was placed in the 101–125 band for Management and 101–150 band among Universities. Globally, it has earned recognition in the Times Higher Education (THE) World University Rankings, ranking 1201–1500 worldwide (2026), 501–600 in Asia (2025), and is the only State Government University in Haryana to be featured in both the Engineering and Physical Sciences subject rankings of THE. The University also ranks 22nd in India in the UI GreenMetric World University Rankings 2024 for environmental sustainability and was awarded UGC Category-II Graded Autonomy. With a Scopus h-index of 132, over 5,357 Scopus-indexed publications, 115,000+ citations, and an impressive average citation per paper of 21.48, GJUST has established itself as a premier center for quality education, cutting-edge research, and global academic collaboration.

Metascitech

MetaSciTech Society is a registered academic and professional body committed to the advancement of science and technology across disciplines. The society brings together esteemed academicians, researchers, scientists, and technologists from around the globe, fostering a collaborative environment for knowledge creation, dissemination, and innovation.
Founded with the vision to bridge research with real-world applications, MetaSciTech Society serves as a platform to encourage high-quality scientific research, facilitate professional development, and promote interdisciplinary collaboration.

Our Vision & Mission:

- **Advancing research and experimental work in the fields of science and technology.**
- **Hosting national and international conferences, workshops, and seminars to encourage academic discourse and innovation.**
- **Publishing directories, proceedings, and scientific literature to strengthen the global knowledge base.**
- **Promoting training, mentoring, and career development opportunities for young researchers and scholars.**
- **Advising on science and technology-related policies and legislation.**
- **Offering awards, scholarships, and recognition to outstanding contributions in science and engineering.**

The society operates solely for educational and professional development purposes, ensuring that all resources are directed toward its mission—without profit distribution to its members. By upholding the highest standards of scientific conduct and discipline, MetaSciTech Society strives to be a leading voice in shaping the future of global science and technology.

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&

MetaSciTech Society, Rohtak, Haryana, India

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Preface

The Abstract Book of the International Conference on Electronic Materials, Semiconductor Devices and Emerging Technologies (ICEMSET-2026) contains the accepted abstracts presented during the conference held from 16–18 November, 2026 organized by Department of Physics, Guru Jambheshwar University of Science & Technology (GJUST), Hisar 124101 Haryana, India and MetaSciTech Society, Rohtak, Haryana, India.

The conference aimed to provide a vibrant international platform for researchers, academicians, scientists, industry professionals, and students to exchange knowledge, present cutting-edge research, and discuss recent advances in electronic materials, semiconductor devices, nanotechnology, optoelectronics, quantum materials, AI-driven technologies, and emerging scientific innovations. The conference featured distinguished plenary lectures, keynote addresses, invited talks, technical sessions, and poster presentations, fostering interdisciplinary collaboration and meaningful interactions between academia, research organizations, and industry.

The editors sincerely acknowledge the valuable contributions of all authors, keynote speakers, invited experts, reviewers, organizing committee members, and participants for making the conference successful. We also express our gratitude to Research Wheel Publishers for publishing this abstract book.

We hope that this publication will serve as a useful reference for researchers and inspire further scientific collaborations and innovations in emerging areas of Electronic Materials, Semiconductor Devices and Emerging Technologies.

Aims of the Conference

The **International Conference on Electronic Materials, Semiconductor Devices and Emerging Technologies (ICEMSET-2026)** aims to provide an international platform for researchers, academicians, scientists, industry professionals, innovators and research scholars to exchange knowledge, share recent scientific advancements and discuss emerging research directions in electronic materials, semiconductor technologies and related interdisciplinary fields.

The major aims of the conference are:

1. **Promoting Scientific Research and Innovation:** To encourage fundamental and applied research in electronic materials, semiconductor devices, nanomaterials, photonic materials and emerging technologies.
2. **Advancing Semiconductor Technologies:** To explore recent developments in semiconductor materials, wide-bandgap semiconductors, microelectronics, nanoelectronics, electronic device fabrication and next-generation semiconductor devices.
3. **Exploring Emerging Materials:** To provide a platform for discussing advances in functional nanomaterials, quantum materials, magnetic, dielectric, ferroelectric, optical and photonic materials.
4. **Encouraging Interdisciplinary Research:** To foster collaboration among physics, materials science, electronics, nanotechnology, biotechnology, engineering, computational science and other emerging research domains.
5. **Bridging Academia and Industry:** To strengthen interactions between academic institutions, research organizations, industrial professionals and technology developers for translating scientific discoveries into practical applications.
6. **Highlighting Sustainable Technologies:** To promote research on energy-efficient electronic materials, renewable energy technologies, sustainable polymers, advanced composites, recycling and environmentally responsible material development.
7. **Integrating Artificial Intelligence and Computational Methods:** To explore the applications of artificial intelligence, machine learning, computational modelling, density functional theory and data-driven approaches in materials discovery and device development.
8. **Promoting Emerging Applications:** To discuss technological advancements in sensors, MEMS/NEMS, smart systems, biomedical materials, smart agriculture, electronic packaging and other next-generation applications.
9. **Developing Research Networks:** To establish national and international collaborations among researchers, institutions, industries and professional organizations.
10. **Encouraging Young Researchers:** To motivate students, research scholars and early-career scientists through scientific presentations, expert interactions, knowledge-sharing sessions and research networking opportunities.

Expected Outcomes

ICEMSET-2026 is expected to generate significant academic, scientific and technological outcomes by bringing together experts and emerging researchers from diverse disciplines. The anticipated outcomes include:

1. **Knowledge Exchange:** Enhanced understanding of recent scientific developments, research challenges and future prospects in electronic materials, semiconductor devices and emerging technologies.
2. **Research Collaboration:** Establishment of new national and international research collaborations, institutional partnerships and interdisciplinary research networks.
3. **Research and Innovation Opportunities:** Identification of promising research areas, innovative ideas and potential technological solutions for addressing contemporary scientific and industrial challenges.
4. **Advancement in Semiconductor Research:** Greater awareness of advanced semiconductor materials, device architectures, fabrication methodologies and their applications in electronics and photonics.
5. **Industry–Academia Interaction:** Strengthened connections between universities, research laboratories and industries, facilitating technology transfer, collaborative projects and practical applications of research outcomes.
6. **Sustainable Technological Development:** Increased emphasis on energy-efficient materials, clean energy technologies, environmentally sustainable materials and resource-efficient manufacturing processes.
7. **AI-Driven Materials Discovery:** Promotion of computational materials science, artificial intelligence and machine learning techniques for accelerating materials discovery, characterization and technological innovation.
8. **Capacity Building:** Enhanced research, presentation, communication and scientific problem-solving skills among students, research scholars and early-career researchers.
9. **Dissemination of Research Findings:** Wider dissemination of innovative research outcomes through conference presentations, scientific discussions and potential publications in relevant scholarly journals and proceedings, subject to their respective review and publication policies.
10. **Future Research Roadmaps:** Identification of emerging research priorities and strategic directions for the development of advanced electronic materials, semiconductor technologies and next-generation smart devices.
11. **Strengthening Scientific Communities:** Development of a vibrant scientific network that encourages continuous interaction, knowledge sharing and long-term cooperation among researchers and professionals.
12. **Contribution to Technological Advancement:** Encouragement of research-driven solutions that contribute to technological self-reliance, industrial competitiveness and sustainable socio-economic development.

Themes of Conference (but not limited to)

The themes for the conference are (but not limited to):

S. No.	Theme	Sub-Themes
1	**Theme 1: Semiconductor Materials and Electronic Devices**	• Wide Bandgap Semiconductors (GaN, SiC, Ga_2O_3) • Compound Semiconductors and Heterostructures • Microelectronics and Nanoelectronics • Electronic Device Fabrication and Characterization • CMOS and Post-CMOS Technologies • Flexible and Printed Electronics
2	**Theme 2: Electronic, Optical and Photonic Materials**	• Optoelectronic Materials and Devices • Light-Emitting Diodes (LEDs) • Photodetectors and Photovoltaics • Laser Materials and Technologies • Optical Coatings and Thin Films • Photonic Crystals and Metamaterials
3	**Theme 3: Functional Nanomaterials and Quantum Materials**	• Low-Dimensional Materials (2D Materials, MXenes, Graphene) • Nanostructured Electronic Materials • Quantum Materials and Quantum Devices • Topological Materials • Spintronic Materials and Devices • Quantum Computing Materials
4	**Theme 4: Sensors, MEMS and Smart Systems**	• Gas, Chemical and Biosensors • Wearable and Flexible Sensors • MEMS/NEMS Technologies • Internet of Things (IoT) Materials • Smart Electronic Systems • Environmental Monitoring Sensors
5	**Theme 5: Magnetic, Dielectric and Ferroelectric Materials**	• Magnetic Thin Films and Nanostructures • Multiferroic and Ferroelectric Materials • Dielectric Materials and Capacitors • Microwave and RF Materials • Magnetoelectronic Devices • Energy-Efficient Electronic Components
6	**Theme 6: Energy Materials for Electronic Applications**	• Thermoelectric Materials and Devices • Electronic Materials for Energy Harvesting • Supercapacitors and Battery Materials • Solid-State Electrolytes • Photovoltaic and Solar Energy Materials • Sustainable Energy Conversion Technologies
7	**Theme 7: Advanced Thin Films and Coating Technologies**	• Thin Film Deposition Techniques • Atomic Layer Deposition (ALD) • Chemical Vapor Deposition (CVD) • Pulsed Laser Deposition (PLD) • Surface Engineering and Interface Science • Electronic Packaging Materials
8	**Theme 8: Materials**	• Advanced Microscopy and Spectroscopy

S. No.	Theme	Sub-Themes
	Characterization and Computational Design	• In-situ and Operando Characterization • Computational Materials Science • Density Functional Theory (DFT) • Machine Learning in Electronic Materials • Digital Materials Design and Discovery
9	**Theme 9: Electronic Packaging, Reliability and Manufacturing**	• Advanced Electronic Packaging • Thermal Management Materials • Reliability and Failure Analysis • Interconnect Technologies • Additive Manufacturing for Electronics • Sustainable Electronic Manufacturing
10	**Theme 10: Emerging Technologies and Future Electronics**	• Neuromorphic Computing Materials • Artificial Intelligence Hardware • Flexible and Stretchable Electronics • Electronic Textiles and Wearable Systems • Bioelectronics and Medical Electronics • Next-Generation Electronic Materials and Devices
11	**Theme 11: Bio-Integrated Materials, Biotechnology and Biomedical Engineering**	• Biomaterials and Bioactive Materials • Tissue Engineering and Regenerative Medicine • Drug Delivery and Therapeutic Materials • Bio-Nanotechnology and Biointerfaces • Biomedical Devices and Implant Materials • Biochemistry and Bioengineering
12	**Theme 12: Smart Agriculture, Food and Veterinary Technologies**	• Nanomaterials for Agriculture • Precision and Smart Agriculture • Agricultural Sensors and IoT • Controlled-Release Fertilizers and Agrochemicals • Food Packaging and Food Safety • Veterinary Biomaterials and Diagnostics
13	**Theme 13: Sustainable Polymers, Composites and Circular Materials**	• Advanced and Functional Polymers • Polymer Nanocomposites • Bio-Based and Biodegradable Materials • Natural-Fiber and Agro-Waste Composites • Recyclable and Self-Healing Materials • Circular Economy and Life-Cycle Assessment
14	**Theme 14: Corrosion, Surface Protection and Industrial Materials Reliability**	• Corrosion Science and Prevention • Smart and Protective Coatings • Surface Engineering and Modification • Tribology and Wear • Corrosion Monitoring and Non-Destructive Testing • AI/ML for Predictive Corrosion Assessment
15	**Theme 15: Computational, AI-Driven and Forensic Materials Science**	• AI/ML for Materials Discovery • Computational Materials Science and Modelling • DFT, Molecular Dynamics and Multiscale Simulation • Digital Twins and Data-Driven Materials Engineering • Forensic Materials and Trace Evidence • AI/ML in Forensic and Analytical Science

About Us

Guru Jambheshwar University of Science & Technology (GJUST), Hisar -125001, Haryana, India

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For more details, visit: https://www.gjust.ac.in/

MetaSciTech Society

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- Offering awards, scholarships, and recognition to outstanding contributions in science and engineering.
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Hon'ble Vice-Chancellor
GJUST Hisar, Haryana, India



PATRON
Dr. Vijay Kumar
Registrar
GJUST Hisar, Haryana, India



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Chairperson Department of Physics
GJUST Hisar, Haryana, India



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Prof. (Dr.) Manjeet Singh Goyat
Cluster of Applied Science
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ORGANIZING SECRETARY
Dr. Vivek Gupta
Assistant Professor Department of
Physics GJUST Hisar, Haryana, India



ORGANISING SECRETARY
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- **Technical Team, MetaSciTech Society, Rohtak, Haryana, India**

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- **Ms. Arti, Department of Physics, GJUST Hisar, Haryana, India**
- **Technical Team, MetaSciTech Society, Rohtak, Haryana, India**

Message from the Chief Patron and Honourable Vice Chancellor

Greetings to everyone participating in ICEMSET-2026, the International Conference on Electronic Materials, Semiconductor Devices, and Emerging Technologies. The Department of Physics at Guru Jambheshwar University of Science & Technology, Hisar, is hosting it together with the MetaSciTech Society, and I am glad to see it come together.

Physics has always moved forward by asking better questions. From the understanding of light and matter to the chips that now run almost every device we use, each advance has grown out of patient laboratory work and open discussion. Gatherings like this one keep that tradition alive. They give young researchers the chance to present their first results and give senior scientists the chance to hear fresh thinking.

Researchers, academicians, scientists, industry professionals and students have come from across India and from abroad. They are working on nanotechnology, optoelectronics, quantum materials, renewableenergy materials, sensors, and AI-driven technologies. This is the kind of research we want from our university: work that adds to what we know and is useful to people. If the talks and discussions over the past few days lead to fresh ideas and working partnerships, the conference will have done its job.

Our university is working to grow as a place where science is practised with care and curiosity. I hope the Department of Physics and our wider campus in Hisar will continue to attract talented students and scholars, and that this conference will strengthen our links with institutions across the country and beyond.

My thanks go to the Convenor, the Chairperson, the Organizing Secretaries and the MetaSciTech Society for the planning and effort behind this event. I also thank the faculty, research scholars, the coordination team, and the supporting staff. Much of what runs smoothly here is down to their hard work.

Our work is guided by the teachings of Guru Jambheshwar Ji Maharaj, who stressed discipline, compassion and care for nature. I hope this conference encourages our students and scholars to pursue knowledge honestly, with a sense of responsibility to people and to the environment.

To all participants, I wish you a productive and rewarding conference. I hope the friendships and professional ties you form in Hisar last well beyond these three days.

With best wishes,

Prof. Vijay Kumar
Chief Patron and Honourable Vice Chancellor,
Guru Jambheshwar University of Science & Technology,
Hisar, Haryana, India

Message from the Patron and Worthy Registrar

Dear Colleagues and Participants,

Warm greetings from all of us at Guru Jambheshwar University of Science & Technology, Hisar. It is a privilege to welcome the delegates of ICEMSET-2026, the International Conference on Electronic Materials, Semiconductor Devices and Emerging Technologies, hosted by the Department of Physics in association with the MetaSciTech Society.

Our university has grown into a campus where teaching, research and service go hand in hand. Its departments span the sciences, engineering and technology, and many of our students and scholars take their first steps in research here. We work to provide laboratories, libraries and academic programmes that support them, and we welcome visiting scholars and institutions who share our aims. Events like ICEMSET show what this community can achieve when people work together.

Gathering nearly 500 minds from across India and beyond is no small achievement. The energy you bring to topics such as nanotechnology, optoelectronics, quantum materials and sensors reflects the university's aspiration to produce research that is both rigorous and useful to society. I encourage you to use these three days to share ideas freely, question boldly and build partnerships that outlast the conference.

My sincere appreciation goes to the Convenor, the Chairperson, the Organizing Secretaries and the MetaSciTech Society for their careful planning. I also thank the faculty, research scholars, coordination team and non-teaching staff, whose quiet dedication behind the scenes has made this gathering possible.

I wish you a fruitful conference and a memorable stay in Hisar.

Warm regards,
Dr Vijay Kumar
Patron and Worthy Registrar,
Guru Jambheshwar University of Science & Technology,
Hisar, Haryana, India

Message from the Convenor & Conference Chair

Dear Colleagues,

Welcome to Hisar, and welcome to ICEMSET-2026.

The Department of Physics and MetaSciTech Society, India, have spent many months preparing for these three days, 16 to 18 November, and it is good to see the conference begin. We are grateful to the MetaSciTech Society for its committed partnership in bringing this conference together.

Around 500 people are taking part from India and abroad, some here in person and some online. The programme covers 15 themes, from semiconductor devices and quantum materials to sensors, energy materials and AI-driven materials science.

For our department, this conference is an important step. Physics teaching and research here have long depended on small groups of scholars working closely together, and this gathering allows them to meet people from other institutions and fields. I hope our research scholars and students will see how their work fits into a wider scientific conversation, and I hope our faculty will return to their laboratories with new questions and new partners.

Electronic materials and semiconductors already shape how we communicate, compute, treat illness and produce energy. Even so, many questions remain open, and new problems keep appearing. That is why I value meetings like this one. You present your work to people in a slightly different area, and they often ask the question you hadn't thought of. I am glad that senior scientists and young researchers are sharing the same rooms.

Our university is named after Guru Jambheshwar Ji Maharaj, whose teachings on discipline, compassion and care for nature still guide us. That is worth remembering when we talk about new technology. What it does to society and the environment matters as much as what it can do. I hope this university, and our department in particular, will keep that spirit at the centre of its research.

I sincerely thank our Chief Patron, Honourable Vice Chancellor Prof. Vijay Kumar, and our Patron, Worthy Registrar Dr. Vijay Kumar, for their guidance and support. I am grateful to our Co-Convenor, Prof. Manjeet Singh Goyat, and to our Organizing Secretaries, Dr. Vivek Gupta and Dr. Amrita Hooda, who carried much of the day-to-day work. I also thank our plenary and invited speakers, authors, reviewers, sponsors, my colleagues in the department, the research scholars, students and non-teaching staff. A conference of this size cannot run without them.

I hope you go home with new ideas, a few new contacts and, if we are lucky, a future collaboration.

Please enjoy your stay in Hisar.

With best wishes,

Prof. RS Kundu,
Convenor & Conference Chair, ICEMSET-2026,
Department of Physics,
Guru Jambheshwar University of Science and Technology,
Hisar, Haryana, India

Message from the Organizing Secretary

On behalf of the Organizing Committee, it is my privilege and pleasure to extend a warm welcome to all delegates, speakers, and participants to the International Conference on Emerging Materials, Science, Engineering & Technology (ICEMSET-2026). Hosted by the Department of Physics at Guru Jambheshwar University of Science & Technology (GJUS&T), Hisar, in association with the MetaSciTech Society, this gathering offers a wonderful platform for sharing research, exchanging ideas, and building lasting academic connections.

Since its inception, the Department of Physics at GJUS&T has strived to create an environment where quality teaching and meaningful research go hand in hand. Over the years, our department has developed into a strong center for study in materials science, condensed matter physics, dielectric ceramics, luminescence, and functional devices. With well-equipped research laboratories, dedicated faculty, and vibrant scholars, we remain committed to nurturing young scientific talent and pushing the boundaries of applied research.

ICEMSET-2026 was envisioned to bring together fundamental scientific insights and real-world technological solutions. Over the course of the conference, keynote talks, technical presentations, and poster sessions will highlight fresh perspectives across advanced materials, nanotechnology, energy applications, and interdisciplinary engineering disciplines.

Putting together an event of this scale—with around 550 expected attendees—takes months of coordinated effort behind the scenes, from managing registrations and paper reviews to arranging technical tracks and logistics. I am deeply thankful to our leadership and Chairperson for their continuous encouragement and guidance. I also want to express my gratitude to Prof. Manjeet Singh Goyat, Dr. Amrita Hooda, and the team at MetaSciTech Society for their unwavering support from day one.

My heartfelt thanks also go out to our faculty colleagues, research scholars, student volunteers, and administrative staff. Their hard work, patience, and meticulous effort behind the scenes are what truly made this conference possible. To all our out-of-town guests and delegates, we are delighted to have you here in Hisar. I hope the sessions are inspiring, the discussions fruitful, and your stay with us enjoyable.

Warm regards,

Dr. Vivek Gupta
Organizing Secretary, ICEMSET-2026
Department of Physics, GJUS&T, Hisar

MetaSciTech Society

REGISTERATION NO. : 01647
DARPAN ID: HR/2025/0628005
PAN: AAYAM3356Q

MESSAGE

It gives me immense pleasure to extend my warm greetings and heartfelt congratulations to all the delegates, researchers, academicians, scientists, industry experts, and students participating in the International Conference on Emerging Trends in Multidisciplinary Science, Engineering and Technology (ICEMSET 2026).

The publication of this Abstract Book marks an important milestone in documenting the diverse, innovative, and significant research contributions presented at the conference. ICEMSET 2026 provides a valuable platform for the exchange of knowledge, ideas, and experiences among researchers and professionals working across multidisciplinary domains of science, engineering, and technology.

I express my sincere gratitude to Guru Jambheshwar University of Science and Technology (GJUST) for its valuable collaboration and support in organising this prestigious international conference. The association and cooperation of GJUST have played a significant role in strengthening the academic vision and successful organisation of ICEMSET 2026.

I am deeply grateful to the Hon'ble Vice-Chancellor, Prof. Dr. Vijay Kumar, for his inspiring leadership, visionary guidance, and constant encouragement. His unwavering support and commitment towards the promotion of academic excellence, research, and innovation have been a great source of motivation for all of us. His guidance has significantly contributed towards making this event a meaningful and successful academic endeavour.

I would also like to express my sincere appreciation and heartfelt thanks to Dr. Rajender Singh Kundu for his valuable support, encouragement, cooperation, and continuous guidance throughout the organization of this conference. His commitment and contribution have been instrumental in helping us transform the vision of ICEMSET 2026 into a successful and impactful event.

In today's rapidly evolving world, interdisciplinary research and collaboration are essential for addressing complex global challenges and creating sustainable solutions. I am confident that the research contributions compiled in this Abstract Book will inspire meaningful discussions, encourage new collaborations, and contribute significantly to future advancements in their respective fields.

I sincerely appreciate the dedicated efforts of the organizing committee, technical committee, reviewers, contributors, collaborators, and all members of the MetaSciTech Society for their commitment and tireless efforts in making ICEMSET 2026 a successful academic platform.

I congratulate all the authors whose valuable research contributions have enriched this Abstract Book. I hope that this conference will serve as a catalyst for innovation, collaboration, knowledge exchange, and continued excellence in research.

I extend my best wishes to ICEMSET 2026 for its grand success and wish all the participants a rewarding, productive, and intellectually enriching experience.

With best wishes,

Prof. (Dr.) Manjeet Singh Goyat
Co-Convenor, ICEMSET 2026
President, MetaSciTech Society

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MetaSciTech Society

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PAN: AAYAM3356Q

MESSAGE

It is a matter of immense pride and privilege to be associated with ICEMSET 2026 at Guru Jambheshwar University of Science & Technology (GJUST), Hisar. Organizing an international academic gathering of this stature is a collective endeavour that reflects the spirit of knowledge, innovation and institutional excellence.

I express my sincere gratitude to the Hon'ble Vice-Chancellor and the esteemed Registrar of GJUST for their visionary leadership, continuous encouragement and generous support in facilitating this academic initiative. Their commitment to promoting quality research, innovation and international academic engagement provides an inspiring foundation for such endeavours.

I also extend my appreciation to Dr. Rajender Singh Kundu, Convenor and Conference Chair, for his dedicated leadership, academic commitment and tireless efforts towards shaping this conference. My sincere compliments to the entire organizing team for their enthusiasm, coordination and commitment to making this event meaningful and successful.

I am particularly grateful to Guru Jambheshwar University of Science & Technology for providing its institutional support, academic environment and platform for bringing together eminent minds from diverse scientific disciplines.
I firmly believe that ICEMSET 2026 will foster meaningful collaborations, encourage young researchers, stimulate innovative thinking and strengthen the bridge between scientific research and technological advancement.
Looking forward to welcoming all distinguished guests, delegates and participants for an enriching academic experience.

With warm regards,

Dr. Amrita Hooda
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Keynote Talks

Nanomedicine in Humans: From Eliminating Implant Infection to Implantable Sensors to AI

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Abstract

Nanomedicine is the use of nanomaterials to improve disease prevention, detection, and treatment which has resulted in hundreds of FDA approved medical products. While nanomedicine has been around for several decades, new technological advances are pushing its boundaries. For example, this presentation will present an over 30-year journey of commercializing nanomaterials for orthopedic implants now in over 45,000 patients to date showing no signs of failure. Current orthopedic implants face a failure rate of 5 – 10% and sometimes as high as 60% for bone cancer patients. Further, this talk will present future research directions into using atomic layer deposition (ALD) to create such nanostructures on implants to reduce infection and improve bone growth. Sensors grown off of orthopedic implants using ALD will also be discussed in which cell presence on orthopedic implants can be detected and quantified. Such information can also be communicated to a handheld device to better inform surgeons on chances of implant success or failure. Such sensors can also release pharmaceutical agents and/or nanoparticles on-demand to ensure implant success. Lastly, this talk will cover how Artificial Intelligence (AI) can be combined into today's orthopedic implants to predict implant success or failure in the years that follow.

Keywords: Nanomedicine; Human Trials; Infection.



Biography: Thomas J. Webster's (H index: 140) degrees are in chemical engineering from the University of Pittsburgh (B.S., 1995; USA) and in biomedical engineering from RPI (Ph.D., 2000; USA). He has formed over a dozen companies who have numerous FDA approved medical products currently improving human health in over 45,000 patients. He is currently helping those companies and serves as a professor at Brown University, Saveetha University, Hebei University of Technology, UFPI, University of the Basque Country, and others. Dr. Webster has numerous awards including: 2020, World Top 2% Scientist by Citations (PLOS); 2020, SCOPUS Highly Cited Research (Top 1% Materials Science and Mixed Fields); 2021, Clarivate Top 0.1% Most Influential Researchers (Pharmacology and Toxicology); 2022, Best Materials Science Scientist by Citations (Research.com); and is a fellow of over 8 societies. Prof. Webster is a former President of the U.S. Society for Biomaterials and has over 1,350 publications to his credit with over 55,000 citations. He was recently nominated for the Nobel Prize in Chemistry. Prof. Webster also recently formed a fund to support Nigerian student research opportunities in the U.S.

The Demand for the Green Electronics of Our Future

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Abstract

The rapid socio-economic expansion, driven by burgeoning demands for smart electronics, energy harvesters, and plastic-based products, has exacerbated climate change while jeopardizing ecological balance and depleting our natural resources (Raghavan et al., 2020; Zhao et al., 2021, Nandy et al 2022). The proliferation of the Internet of Things (IoT) and wearable devices intensifies these challenges, highlighting the urgent need for high-resolution communication interfaces (Mishra et al., 2022, Rogdakis et al 2024). This technological transformation necessitates a decisive shift toward green technologies that prioritize environmental sustainability, particularly by investigating alternatives to silicon-based materials (Martins et al., 2020; Fortunato, E (2012). Emerging nanoscale devices show considerable promise as eco-sustainable substitutes that can outperform traditional silicon solutions, facilitating innovative advancements in electronic design, especially in the realms of transparent and paper electronics (Martins, R. et al (2011); Fortunato, E (2018), Martins et al., 2021, Fagas, G et al 2024). This presentation will discuss strategies to tackle these intertwined challenges by reducing electronic waste (e-waste) while promoting sustainable technological solutions (Jha et al., 2020, Nandy et al 2021). Our dedication to developing eco-friendly electronics and energy harvesters aligns with both consumer needs and principles of environmental stewardship. Additionally, we are committed to raising social awareness regarding sustainable technologies. By collaborating with communities, businesses, and policymakers, we aim to advocate for practices that can transform industry and societal norms. Through innovative business models and the promotion of sustainable lifestyles, we aspire to create a future in which technology and environmental responsibility coexist, fostering a sustainable world for future generations (Choudhury et al., 2021). We invite attendees to engage in collaborative strategies to confront these pressing challenges and drive the transition toward a more sustainable future (Fagas, et all 2024), where advanced materials are the key vector for our prosperity. Collectively, we can significantly impact our environment and society, nurturing a resilient world powered by green technology.

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Biography: Rodrigo Martins, full professor at FCT-NOVA, expert in Advanced Functional Materials for electronics and energy applications, with more than 1370 papers published, cited more than 43100, with an h-index of 102; running president of the European Academy of Sciences, director of the Associated Laboratory i3N, the Institute of Nanostructures, Nanomodeling and Nanofabrication; former: President of International Union of Materials Research Society - IUMRS; member of the Scientific Council of the European Research Council; member of the Advisory Council of DG prosperity in the frame of European Programme Horizon (2014-2016). Coordinator of the Emerging Printed Electronics Research Infrastructure (EMERGE) the first in Europe beyond Silicon.

▪ President of the administration board of the Portuguese cluster in Advanced Materials (NANOMAT); member of the administration board of the Portuguese cluster on Batteries (BatPower); Chair of the European Committee Affairs of European Materials Research Society. He is a member of: the Academia Europaea; Royal Academy of Sciences and Arts of Barcelona; Portuguese Academy of Engineering; European Academy of Sciences; the Portuguese Order of Engineers, OE, and of the Board of Admission and Qualification of OE. QiuShi Chair Visiting Professor at Zhejiang University; Honorary Professor of Hefei Institutes of Physical Sciences of the Chinese Academy of Sciences (CAS); Honorary Professor of the Technical University of Wuhan and of the School Chemistry, Chemical Engineering and Life Sciences of Wuhan University; Honorary Professor of Fuzhou University, Invited Professor at Southwest University, Chongqing, China. In 2023 selected as PIFI Distinguished Scientist of Chinese Academy of Sciences, the highest honour for overseas talents. He got more than 20 distinctions and awards, such as Professor Honoris Causa by University of Galati, Romania. In 2021 he got the Career and Recognition Award given by the Portuguese Society of Materials and the Research Nova-Altice Award. He is the editor in chief of the journal Discover Materials. Member of the international committee of ITC2025. Member of the advisory board (2025-2027) of the European University for Customized Education (EUNICE), Member of the editorial board of the journal Innovation Material (2025-2027).

Co-chair of the FNRS (Fonds de la Recherche Scientifique, Belgium) Quinquennial Scientific Prize, A DE LEEUW-DAMRY-BOURLART Prize in Applied Exact Sciences
Member of the jury Rei Jaume I Prize in New Technologies for 2025, Valencia 2-3 June, Spain.
Co-Chair of the Organizing Committee for IUMRS-ICA 2025, the 9th World Materials Summit and International Union of Materials Societies International Conference in Asia Guilin, 14-17 October 2025.
(see more at https://drive.google.com/file/d/1_ViQHV0z42ZuCRkXs0L6EJeY3Ri-mY3o/view?usp=drive_link)

DFT screening of Advanced 2D magnetic materials and their van der Waals Heterostructures

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Abstract

With improvements in fabrication techniques, the era of van der Waals heterostructures has come into the picture very quickly in recent years. These heterostructures consist of the layers of different 2D materials and are arranged in a way as Lego bricks are stacked in a specific order. Making a heterostructure is an efficient way to combine the properties of two distinct 2D materials in one material and the latest attention in this area is on heterostructures in which graphene represents one layer and the second layer belongs to any other 2D material. The density functional theory (DFT) is a computational simulation method based on the principles of quantum mechanics which can predict the ground state properties of not only already existing materials, but also of those materials which have not even been synthesized to date. In this talk, the basic principle of DFT will be addressed. The recent DFT results of our research group for novel 2D van der Waals heterostructures having one layer made up of graphene and showing applications in the area of magnetism and spintronics will also be explained.

Keywords: Photovoltaics, Solar Energy, Perovskites, Power conversion efficiency, Renewable energy.



Biogaphy: Prof. Manish K. Kashyap is a Professor of Physics at the School of Physical Sciences, Jawaharlal Nehru University (JNU), New Delhi, where he has been serving since December 2020. Previously, he served as Associate Professor and Assistant Professor at the Department of Physics, Kurukshetra University, Kurukshetra, Haryana, from November 2019 to December 2020 and November 2007 to November 2019, respectively. He also worked as Assistant Professor at Government College, Naraingarh, Ambala, Haryana, from July 2006 to November 2007. He completed his M.Sc. in Physics from Kurukshetra University and earned his Ph.D. from IIT Roorkee under the supervision of Prof. Sushil Auluck and Prof. Tashi Nautiyal. He received Gold Medals in both B.Sc. and M.Sc. Physics for securing university top positions in 2001 and 2003, respectively. He subsequently undertook postdoctoral research at Ames Laboratory, USA, from August 2016 to July 2017 under the UGC-Raman Fellowship, working with Prof. Bruce Harmon. Prof. Kashyap has published over 135 research papers in reputed international journals and conference proceedings. His research interests include theoretical condensed matter physics, materials science, plasma physics, accelerator physics, two-dimensional materials and heterostructures, hybrid halide perovskites, magnetic materials, spintronics, and density functional theory simulations. He has established international research collaborations with institutions in the USA, Czech Republic, and Italy. He has guided 11 Ph.D. scholars and one postdoctoral researcher, while seven Ph.D. scholars are currently working under his supervision. He has completed four research projects funded by agencies including UGC, DST-SERB, DST Haryana, the IKS Division, and AICTE. He is a life member of IAPT, the Indian Science Congress, and the Indian Physics Association. His teaching interests include quantum mechanics, classical mechanics, mathematical physics, condensed matter physics, and electrodynamics.

Faculty / Scientist (Invited) Talks

ICEMSET-2026/FS/INV/101

Synthesis, Characterization, and Enhanced Photocatalytic Performance of Y-Doped CuO Nanoparticles

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Abstract

This study reports the synthesis of pristine copper oxide nanoparticles (CuO NPs) and yttrium-doped copper oxide nanoparticles (Y-CuO NPs) with varying yttrium concentrations (1%, 3%, and 5%) using a hybrid ultrasonication-assisted co-precipitation method. The primary objective of the work was to investigate the effect of yttrium doping on the structural and optical properties of CuO nanoparticles and to explore their potential environmental and biomedical applications. The synthesized nanoparticles were characterized using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), and UV–visible spectroscopy. XRD analysis confirmed the formation of crystalline monoclinic CuO structures with successful incorporation of yttrium ions without the formation of secondary impurity phases. FTIR spectra verified the presence of characteristic Cu–O vibrational bands, while UV–visible analysis revealed enhanced visible light absorption and a slight modification in band gap energy for the Y-doped samples compared to pristine CuO. The application performance of the synthesized nanomaterials was evaluated through photocatalytic degradation of Acid Orange dye under UV–visible light irradiation. Among all samples, Y-doped CuO nanoparticles demonstrated improved functional performance, achieving up to 95% dye degradation efficiency compared to 93% for pristine CuO, which can be attributed to enhanced charge carrier separation and reduced electron–hole recombination due to yttrium incorporation. These findings suggest that yttrium doping significantly improves the physicochemical and application-oriented properties of CuO nanoparticles, making them promising candidates for sustainable wastewater treatment and antimicrobial technologies.

Keywords: Copper oxide nanoparticles, Ultrasonication-assisted co-precipitation, Photocatalytic degradation.

ICEMSET-2026/FS/INV/102

From Smart Sensors to Secure Intelligence: AI, Edge Computing, and Cybersecurity for Next-Generation Electronic Systems

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Abstract

Smart sensors, IoT devices, edge computing, and AI are converging into a new generation of electronic systems for healthcare, industry, transportation, and smart cities. As these systems get more autonomous and more connected, security, reliability, and trust have to be part of the design from the start. This talk presents a framework combining edge AI, deep learning-based anomaly detection, lightweight cryptography, blockchain-based trust management, and secure communication protocols for intelligent electronic environments. Running analytics at the edge cuts latency, keeps data private, and helps systems stay operational under stress. Case studies cover IoT security, wearable sensing, deepfake detection, and large language model securityeach showing how to mitigate threats even on devices with limited compute and power. The talk ends by looking at what's still unresolved: how to make edge intelligence something users can actually trust, how to secure autonomous electronic systems at scale, and what a sustainable approach to AI-driven infrastructure should look like.

Keywords: Edge AI security, IoT trust management, Anomaly detection, Secure communication protocols.

ICEMSET-2026/FS/INV/103

Ferromagnetism in nanocrystalline Mn doped CeO_2 for Spintronics applications

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Abstract

We report room temperature ferromagnetism in $Ce_{1-x}Mn_xO_2$ nanocrystalline powders prepared by chemical co-precipitation method. Phase analysis using XRD reveal single phase formation for the samples with $x \leq 0.08$. The change in lattice parameter for Mn doped CeO_2 account for the substitution of Mn ions into the host material. However, an impurity peak that corresponds to Mn_3O_4 was found in samples with $x \leq 0.08$. EDX results confirm the near stoichiometry of the samples and there is a nominal variation due to the random alloying of the dopants. SEM micrographs of $Ce_{1-x}Mn_xO_2$ clearly illustrate the nanocrystalline nature, considerable particle size distribution and aggregation of particles. M-H curve of undoped CeO_2 clearly exhibit a dominant diamagnetic behavior whereas a ferromagnetic signature is seen for phase pure Mn doped CeO_2 samples, making it a potential candidate for spintronics applications. However, the ferromagnetic signal grows weaker and the hysteresis loop does not saturate for higher Mn concentration ($x \geq 0.08$), which is possibly due to the increase in antiferromagnetic interaction arising from greater superexchange interaction among the neighboring Mn ions.

Keywords: Spintronics, Diluted Magnetic Oxides, Room Temperature Ferromagnetism, CeO_2, Mn doping.

ICEMSET-2026/FS/INV/104

Layered Double Hydroxides in Hybrid Zn-Ion Capacitors: Materials Design and Energy Storage Performance

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Abstract

The development of safe and high-performance aqueous hybrid zinc-ion capacitors (ZICs) has stimulated extensive research on layered double hydroxides (LDHs) owing to their tunable composition, layered structure, and rich redox chemistry. This presentation highlights our systematic strategies to enhance LDH electrochemical performance through substrate engineering, heterointerface construction, transition metal oxide integration, and lattice modulation. Binder-free MnFe-LDH nanosheets were directly electrodeposited on conductive nickel foam and further extended to flexible solid-state ZICs. A conductive Ni_3P@NiAl-LDH heterostructure was subsequently developed to accelerate charge-transfer kinetics and improve redox activity. Rational Zn^{2+}/Al^{3+} doping of MnFe-LDH, supported by density functional theory calculations, demonstrated that Zn doping enhances ion diffusion and electronic conductivity through defect engineering and favorable orbital hybridization. Finally, a NiCo-LDH@Co_3O_4 oxide/hydroxide heterostructure further improved pseudocapacitive behavior and cycling stability. These studies establish rational LDH engineering as an effective route toward high-performance, durable, and scalable aqueous ZICs for next-generation energy storage applications.

Keywords: Layered Double Hydroxides, Aqueous Zn-ion Capacitors, Heterointerface Engineering, Transition Metal Oxides, Density Functional Theory.

ICEMSET-2026/FS/INV/106

An all-optical logic half adder operation based on photonic crystal fiber coupler in a solitonic regime

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Abstract

All-optical solitons play a significant role in diverse applications for all-optical signal processing and computing owing to their robust shape-preserving capability and low attenuation. For such applications in the solitonic regime, high nonlinearity and negative group velocity dispersion are crucial parameters. Thus, the present study aims to model a triple core photonic crystal fiber coupler that can support an all-optical solitonic regime for the

delivery of half adder functionality. The necessary optical parameters, which include the intercore coupling length, group velocity dispersion parameter, nonlinearity parameter, and confinement loss, were evaluated using the effective refractive indices obtained employing the finite element method. These parameters were incorporated into the governing coupled nonlinear Schrödinger equations to determine the control signal power required to calculate the extinction ratios. Through extinction ratio calculations at different control signal phase values, the half adder operation is performed. In addition, a figure of merit was determined to analyze the performance of the half adder.

Keywords: All-optical switching, all-optical logic gates, all-optical solitons, photonic crystal fiber couplers, coupled nonlinear Schrödinger equations, finite element method, split step Fourier algorithm.

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ICEMSET-2026/FS/INV/107

Satya-Check: A Dual-Architecture Multilingual Fake News Detection System for the Indian WhatsApp Ecosystem

Anjani Kumar, Vineet Sharma, Chaitanya Singh
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Abstract

The proliferation of digital misinformation on encrypted platforms like WhatsApp poses a severe societal threat in India, exacerbated by the prevalence of "Hinglish" (code-mixed Hindi-English). Standard automated moderation tools fail against this linguistic fluidity. This report details the development and optimization of Satya-Check, an automated, multimodal detection network utilizing a hybrid "Dual-Brain" architecture. We circumvented the catastrophic linguistic failures of algorithmic transliteration—specifically the Schwa Deletion Problem—by fine-tuning the MuRIL (Multilingual Representations for Indian Languages) cross-lingual transformer on a human-verified native Devanagari dataset (20,593 samples) to achieve zero-shot cross-lingual transfer. To resolve the context blindness inherent in pure linguistic classification, we engineered a secondary live Semantic Fact-Checking pipeline. This layer extracts entities via Regex and verifies claims against a trusted whitelist using the all-MiniLM-L6-v2 sentence transformer. Through rigorous optimization, including a strategic reduction of the semantic cosine similarity threshold to 0.55 to accommodate conversational syntax, the system achieved a baseline Accuracy of 99.7% and Recall of 99.07%. Comprehensive ablation studies mathematically validate the necessity of this hybrid approach against traditional baselines, establishing Satya-Check as a highly scalable, ethically sound first line of defense for non-technical users.

Keywords: Misinformation Detection, Code-Mixed Language, Hinglish, Deep Learning, MuRIL, Sentence Transformers, Fact-checking.

ICEMSET-2026/FS/INV/108

Next-Generation Nano-Hybrid Coatings: Innovations in Corrosion and Fouling Protection

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Abstract

The development of environmentally friendly multifunctional protective coatings has attracted considerable attention for extending the service life of metallic structures operating in aggressive marine and industrial environments. This keynote presentation focuses on the design, fabrication, and characterization of non-toxic epoxy nano-hybrid coatings reinforced with silane-functionalized titanium dioxide (TiO_2) nanoparticles for enhanced corrosion, antimicrobial, and antifouling performance. Diglycidyl ether of bisphenol-A (DGEBA) epoxy resin was employed as the coating matrix, while 3-aminopropyltriethoxysilane (APTES) was used to functionalize TiO_2 nanoparticles, improving their dispersion, interfacial adhesion, and compatibility with the

epoxy network. Nano-hybrid coatings containing different nanoparticle loadings (1, 3, 5, and 7 wt%) were synthesized and systematically evaluated using Electrochemical Impedance Spectroscopy (EIS), long-term immersion in 3.5% NaCl solution, and static marine exposure tests conducted in the Bay of Bengal (Muttukadu, Chennai). Among the investigated formulations, the coating containing 3 wt% APTES-functionalized TiO_2 exhibited the highest corrosion resistance, achieving an impedance value of approximately 10^8 $\Omega \cdot cm^2$ after 30 days of immersion, while demonstrating excellent antifouling performance under natural seawater exposure for up to six months. The results emphasize the critical role of nanoparticle surface functionalization and optimized filler loading in enhancing the barrier properties, mechanical stability, and multifunctional performance of epoxy coatings. The developed TiO_2-based nano-hybrid coatings provide a sustainable and high-performance solution for corrosion protection, antimicrobial activity, and marine biofouling control, offering significant potential for long-term applications in marine, offshore, and industrial infrastructure.

Keywords: Epoxy nano-hybrid coatings, TiO_2 nanoparticles, Surface functionalization, Corrosion resistance, Antimicrobial coatings, Antifouling, Marine protective coatings.

ICEMSET-2026/FS/INV/109

Gallium Nitride (GaN) HEMTs: Powering the Future of Intelligent Electronics

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Abstract

Gallium Nitride (GaN) High Electron Mobility Transistors (HEMTs) are revolutionizing modern electronics by delivering higher efficiency, faster switching, and greater power density than conventional silicon devices. These remarkable capabilities are driving breakthroughs in 5G/6G communications, electric vehicles, renewable energy, aerospace, satellite technology, and advanced defense systems. This talk will take participants on an engaging journey through the fundamentals of GaN HEMTs, exploring the science behind the two-dimensional electron gas (2DEG), advanced device architectures, and recent innovations in wide-bandgap semiconductor technology. The session will also discuss key challenges related to device reliability, thermal management, and radiation effects, while highlighting emerging research trends and future opportunities. Participants will gain valuable insights into how GaN HEMTs are enabling the next generation of faster, smarter, and more energy-efficient electronic systems.

Keywords: GaN HEMT, Power Electronics, Neutron irradiation, Frequency response, Temperature dependence

ICEMSET-2026/FS/INV/110

Designing Efficient and Stable Lead-Less ABX3 Perovskites for Solar Cells

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Abstract

To address the toxicity of lead-based ABX_3 organic-inorganic hybrid halide perovskites (OIHP) without sacrificing performance, this study evaluates three strategies: Sn/Ge substitution for Pb, B-site metal cation mixing, and A-site organic/inorganic cation mixing. Assessments of structural and thermodynamic stability-specifically the tolerance factor, octahedral factor, and formation energy confirm that these methods produce stable three-dimensional (3D) structures. The engineered materials feature favorable band gaps and peak absorption within the visible spectrum. Crucially, several candidates exhibit theoretical power conversion efficiencies (PCE) exceeding 15%. These results demonstrate that cation engineering and substitution are effective pathways for developing less toxic, high-performance ABX_3 -type OIHP materials for advanced photovoltaic applications.

Keywords: OIHP; ABX_3; tolerance factor; PCE.

ICEMSET-2026/FS/INV/111

Inorganic-Organic Nanohybrids for Solid State White Light Emitting Diodes

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Abstract

Developing technology of generating white light is extremely importance for the design of the next generation of energy-efficient smart lighting sources. Here we describe tunable white light emission of hybrid organic-inorganic nanostructures based on colloidal ZnO nanocrystals conjugated with organic fluorophores. This hybrid nanoconjugate acts as 'single-nanophosphor' owing to the electronic coupling between ZnO NCs and the organic dye by FRET. The energy transfer is enabled by the spectral overlap between a broad native defect-induced emission band of ZnO NCs and absorption of conjugated dye molecules. The ability to modulate blue ZnO emission by NC size and the orange-red dye emission by the type and concentration of molecular conjugates allows for a precise tuning of the white light. More importantly, rare-earth or heavy metal free colloidal form of these NCs allows for their easy manipulation through simple chemical means as well as their incorporation into light emitting devices.

Keywords: Inorganic-inorganic hybrid nanostructure; ZnO; Defect emission: FRET; Light emitting device.

ICEMSET-2026/FS/INV/112

Disease Detection of Guava leaf using Guava-CNN in Real Environment

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Abstract

Guava (Psidium guajava L.) is an economically important horticultural crop whose productivity is significantly affected by various foliar diseases, including anthracnose, canker, rust, algal leaf spot, mummification, and wilt. Conventional disease diagnosis relies on manual visual inspection, which is often labor-intensive, subjective, and unsuitable for large-scale agricultural applications. Recent advances in deep learning have demonstrated considerable potential for automated plant disease diagnosis; however, challenges such as variations in illumination, complex backgrounds, and inter-class similarity continue to affect classification performance. This study presents an intelligent deep learning framework for automatic guava leaf disease identification using transfer learning and advanced image preprocessing techniques. The proposed approach is trained on a multi-class dataset containing healthy and diseased guava leaf images and incorporates data augmentation to improve model generalization and reduce overfitting. Extensive experiments are conducted using standard evaluation metrics, including accuracy, precision, recall, F1-score, confusion matrix, and Receiver Operating Characteristic (ROC) analysis. The proposed model achieves an overall classification accuracy of 99.0%, outperforming several state-of-the-art convolutional neural network architectures while maintaining robust performance across all disease categories. Experimental results demonstrate excellent feature discrimination, high sensitivity, and reliable disease recognition under varying imaging conditions. The proposed framework provides a fast, accurate, and computationally efficient solution for early guava disease diagnosis and has significant potential for deployment in precision agriculture, smart farming systems, and mobile-assisted crop monitoring applications.

ICEMSET-2026/FS/INV/113

PCDTBT: PCBM Blended/ZnO QDs Based Self-Powered Solution Processed Broadband Photodetector

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Abstract

This work focuses on the development and optoelectronic performance evaluation of a self-powered broadband photodetector based on a solution-processed ZnO QDs/PCDTBT: PCBM hybrid material system. The active layer consists of Poly[N-9″-heptadecanyl-2,7-carbazole-alt-5,5-(4′,7′-di-2-thienyl-2′,1′,3′-benzothiadiazole)] (PCDTBT) blended with [6,6]-phenyl-C_{61}-butyric acid methyl ester (PCBM), integrated with ZnO Quantum Dots layer to form an efficient organic–inorganic heterojunction. Under monochromatic illumination (100 mW/cm²) and a voltage sweep from −0.5 to 0.5 V, the device exhibits strong self-powered photodetection, with a photocurrent enhancement of ~3384 times at zero external bias. A notable responsivity ~1.86 A/W is achieved over a broad spectral range from 300 to 700 nm under zero-bias operation condition. These results highlight the critical role of material selection and interfacial engineering in achieving high-performance, low-power optoelectronic devices.

Keywords: Self Powered, Blended and Organic photodetector, Heterostructures, Hybrid, Responsovity.

ICEMSET-2026/FS/INV/114

Copper-Induced Modification of Optical and Luminescence Properties in ZnS Nanostructured Thin Films

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Abstract

Cu-incorporated ZnS nanostructured semiconductor thin films were synthesized using RF magnetron sputtering, and the role of Cu doping in tailoring their nonlinear optical and luminescence properties was investigated. The nonlinear optical response of the films was governed by two-photon absorption coupled with free-carrier absorption. Increasing Cu concentration resulted in a lower optical limiting threshold and enhanced third-order optical nonlinearity, attributed to the formation of localized Cu-induced defect states within the ZnS band gap. Photoluminescence studies revealed enhanced emission intensity together with the emergence of a characteristic green emission band, indicating the activation of Cu-related luminescent centers. Time-resolved photoluminescence measurements exhibited a slower decay component, confirming the presence of localized Cu states responsible for efficient radiative recombination. The observed improvements in nonlinear optical and luminescence characteristics demonstrate that Cu doping effectively tailors the functional properties of ZnS semiconductor thin films, highlighting their potential for advanced optoelectronic, photonic, and semiconductor device applications.

Keywords: Two photon absorption, Optical limiting, Cu-activated green emission, Time correlated single photon counting.

ICEMSET-2026/FS/INV/115

Natural Convection of Jeffrey Nanofluid Layer in Magnetic Field

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Abstract

This paper deals with the natural convection of nanofluid layer in magnetic field. The rheology of the regular fluid is described by Jeffrey model using Boungiorno model for nanofluid. The impact of Brownonian motion and thermophoresis is considered. The modified equations of motion are due to the presence of magnetic field. A linear stability analysis is based upon normal mode technique is used to obtain analytical and numerical solution of the nanofluid layer between two stress-free boundaries. The expressions for thermal Rayleigh number for the stationary convection is derived. The stabilizing and destabilizing effects of magnetic Rayleigh number, Lewis number, modified diffusivity ratio, Jeffrey parameter and nanoparticles Rayleigh number on the onset of stationary modes under certain wave number are discussed analytically and numerically. In the end results are depicted graphically.

Keywords: Magnetic field, Nanofluid, Brownian motion, and One-term GWRM.

ICEMSET-2026/FS/INV/116

Carbon Dots from Natural Precursors: Optical, Sensing and Emerging Functional Applications

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Abstract

Carbon dots are versatile carbon-based nanomaterials with tunable physical and chemical properties. They have potential uses in sensing, photocatalysis, biomedicine, and optoelectronic technologies. The choice of precursor affects the structure and surface features of the carbon dots, which in turn influence their function. Using different natural precursors, such as bornyl acetate and myricetin, allows researchers to study how these starting materials change the properties of the carbon dots. By using a range of approaches to analyze their structure, appearance, and behavior in solutions, we can better understand how the chemistry of the precursor shapes the final material. Studying their optical properties and performance in sensing and photocatalytic applications can help link structure to function. This knowledge can guide the design of carbon dots for new uses. Focusing on the choice of precursor helps to produce versatile carbon-based nanomaterials for optical, sensing, and advanced electronic materials research.

Keywords: Carbon dot, Phytochemicals, Optical properties, Sensing, Functional nanomaterials.

ICEMSET-2026/FS/INV/117

Green Synthesis and Characterization of *Mentha arvensis* and *Piper betel* Nanoparticle Formulations

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Abstract

A biodegradable hydrogel scaffold derived from medicinal plant extracts supports cell adhesion and proliferation, delivers bioactive phytocompounds, and enables controlled drug release. Its porous, biocompatible matrix promotes tissue regeneration, reduces inflammation, and offers antimicrobial protection, making it a promising, ecofriendly platform for wound healing and localized therapy. The present study aimed to synthesize eco-friendly zinc oxide (ZnO) nanoparticles doped with silver (Ag). Ethyl acetate Soxhlet extraction was performed on *Mentha arvensis* and *Piper betel*, and standard assays quantified phenolic, flavonoid, and alkaloid contents. Using the polyherbal extract and a sol-gel method, silver–zinc oxide nanocomposites (Ag–ZnO NCs) were synthesized. UV–visible spectroscopy and scanning electron microscopy confirmed metal ion reduction. The polyherbal extract contained higher amounts of phenols, flavonoids, and alkaloids than the individual plant extracts. Fourier transform infrared spectroscopy (FTIR) and zeta size analysis identified the functional groups and particle size of Ag–ZnO NCs, while SEM showed the nanocomposites to be spherical. The Ag–ZnO NCs demonstrated superior antimicrobial activity against all tested pathogens compared with the extract alone, with the strongest antibacterial effect observed at 50 µg for the nanocomposites and at 200 µg for the extract. At a low concentration (500 µg/mL), the biosynthesized nanoparticles produced a pronounced anti-inflammatory effect of 68%, exceeding that of diclofenac sodium. Ag-ZnO nanoparticles also displayed potent antibacterial activity against *Lactobacillus* isolated from dental caries. Phytocomponents may reduce dental caries; antimicrobial activity was evaluated by measuring zones of inhibition. The largest zone of inhibition (18 mm) was observed for *Mentha arvensis* indicating its potential to reduce cavities. The nanoparticles were then incorporated into a hydrogel-based microneedle matrix using freeze-drying and oven-drying techniques. The hydrogel was characterized by FTIR, SEM, and stereomicroscopy, and its drug-release behavior was tested in saline. This hydrogel microneedle system represents a simple, low-cost, biocompatible, and effective approach for transdermal drug delivery.

Keywords: Green Silver nanoparticles, *Mentha arvensis*, *Piper betel*, Nanocomposite, Dental Caries.

ICEMSET-2026/FS/INV/118

Human-Centric Safety-Aware Wearable Antenna Engineering (H-SAWE)

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Abstract

The rapid evolution of 5G/6G wireless communication systems is transforming wearable antennas into key enabling components of human-centric communication networks, supporting applications such as wireless body area networks, intelligent healthcare, extended reality, smart textiles, digital twins, and the Internet of Medical Things. Unlike conventional antennas, wearable antennas operate in close proximity to biological tissues and it calls for research on human safety. Although substantial research has been reported on flexible materials, textile antennas, metamaterials, and electromagnetic band-gap structures, existing studies remain fragmented, typically addressing antenna performance, material selection, or specific absorption rate (SAR) independently. A comprehensive safety-oriented solution strategies is still lacking. This paper presents a critical review of wearable antenna technologies for 5G and emerging 6G networks from the perspective of human-centric safety-aware antenna design. A multidimensional taxonomy is proposed that classifies existing research according to substrate materials, antenna architectures, body-placement strategies, electromagnetic interaction with biological tissues, SAR characteristics, thermal effects, and communication performance. Furthermore, quantitative comparison tables and a research-gap matrix are developed to identify unresolved scientific and engineering challenges. Particular emphasis is placed on the influence of the critical parameters like anatomical placement, and electromagnetic exposure on antenna efficiency. Finally, a unified research framework is proposed for such antennas. The review is intended to serve as both a comprehensive reference for researchers and a structured roadmap for the development of high-performance, low-SAR, thermally safe wearable antennas for future 5G and 6G body-centric communication systems.

Keywords: 5G/6G, Wearable, Human Safety, Specific Absorption Rate, body-centric.

ICEMSET-2026/FS/INV/119

Graph-Theoretic Approaches to Security Analysis in the Post-Quantum Era

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Abstract

The rise of quantum computing will take security concerns to new levels with respect to future electronic and communication systems. This work leverages the rapidly growing field of graph theory and its usefulness for the modeling for complex networks. This research investigates how graph theory can be used for security analysis in a post-quantum world. To that end, this work develops a framework that combines graph theory and Post-Quantum Cryptography (PQC) to study the dependencies of cryptography in a network, identify attack routes, and analyze system vulnerabilities and network components regarding both classical and quantum cyber threats. The framework also facilitates the use of PQC in a network by allowing the placement and prioritization of PQC where it is needed the most. The work intends to offer a structured method for assessing a network's security and integrity in the next generation of electronic infrastructures. The research also demonstrates the versatility of graph theory in security analysis and the potentially novel solutions it can provide in a post-quantum world regarding electronic systems and security. Finally, this work suggests future potential lines of research located at the crossroad of graph theory, cyber security, post-quantum cryptography, and future electronic technology.

Keywords: Graph Theory, Post-Quantum Cryptography, Complex Networks, Cybersecurity, Quantum-Resistant Security.

ICEMSET-2026/FS/INV/120

Waste Recycling Technologies for Nanomaterial Manufacturing Sustainability

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Abstract

Waste accumulation is a serious environmental problem. Therefore, recycling waste into valuable nanomaterials is highly required, where it has environmental and economic benefits. In addition, nowadays, nanomaterials are used in many areas and applications, including medicine, energy, and the environment. The initial cost of the nanomaterials is high; thus, finding another cheap source is required. Electrochemical materials, including metal oxides (MnO_2 and Co_3O_4), carbon-based materials (CNS), and their composites (MnO_2/rGO), have been prepared in diverse morphologies (nanoflowers and nanosheets) from waste precursors. These waste precursors include spent batteries (Zn-C and LiB) and agriculture waste (oil palm leaves, lablabs, palm kernel shells, and eggshells). Different physical and chemical characterizations were conducted to investigate the material structure and morphology. The electrochemical properties of these materials have been studied comprehensively using cyclic voltammetry, galvanostatic charge-discharge, and electrochemical impedance spectroscopy to evaluate their suitability for supercapacitive energy storage. Therefore, an asymmetrical supercapacitor was fabricated and electrochemically evaluated. It shows a superb supercapacitive performance.

Keywords: Nanoflowers, Battery Recycling, electrodeposition, Supercapacitance, Cyclic Voltammetry.

ICEMSET-2026/FS/INV/122

Effect of Calcination Temperature on the Structural Properties and Visible-Light-Driven Photocatalytic Performance of Zinc Vanadate Nanostructures

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Abstract

Photocatalysis has emerged as a promising and sustainable technology for environmental remediation owing to its ability to efficiently degrade organic pollutants under light irradiation. In this work Zinc vanadate (ZV) nanostructures were synthesised by a simple co-precipitation method, and the effect of calcination temperature (T_{cal}) on their structural, optical, and photocatalytic properties was systematically investigated. XRD, FESEM, EDX, FTIR, and BET analyses revealed a T_{cal} dependent phase transformation from $Zn_3V_2O_7(OH)_2(H_2O)_2$ to mixed phases of ZnV_2O_6, $Zn_2V_2O_7$, and $Zn_3V_2O_8$, accompanied by significant changes in surface morphology, whereas Tauc plot gives optical band gap in the range of 2.52 and 2.94 eV. Visible light driven photocatalytic studies on dye methylene blue for 4 hours exhibited the highest degradation efficiency of 88.6% for sample calcined at 300 °C, owing to its favourable phase composition, enhanced surface adsorption, efficient visible-light absorption, and reduced charge-carrier recombination. The results demonstrate that T_{cal} plays a crucial role in tailoring the physicochemical properties and photocatalytic performance of zinc vanadate nanostructures, highlighting their potential for visible-light-driven environmental remediation.

Keywords: Zinc vanadate nanostructures; environment; photocatalytic degradation; methylene blue; co-precipitation method.

ICEMSET-2026/FS/INV/123

Electronic Device Engineering and Electrical Conductivity of 2D Coordination Polymers

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Abstract

2D coordination polymers (CPs) have emerged as capable materials for next-generation electronics owing to their adaptable structures and efficient charge-transport properties. This discussion will highlight the structure-activity relations leading electrical conductivity and device performance, with prominence on the roles of conjugated/redox-active ligands, long-range crystallinity, and supramolecular interactions such as π-π stacking, hydrogen bonding, halogen bonding etc. Post-synthetic structural modifications of CPs played an imported role in charge transportation and active electronic device fabrication. The combination of 2D CPs into Schottky barrier diodes, field-effect transistors, solar cells, light-emitting diodes, and sensors will be discussed, providing insights into the rational design of high-performance materials for sustainable electronic and energy technologies.

Keywords: Coordination Polymers, Semiconductors, electronic devices, diodes.

ICEMSET-2026/FS/INV/124

A Sustainable Hybrid Composite Electrolyte Strategy for Advanced Lithium-Metal Batteries

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Abstract

The development of safe and high-performance lithium-metal batteries requires advanced electrolyte membranes capable of enhancing ion transport while suppressing lithium dendrite growth. In this work, a sustainable hybrid biopolymer-based composite electrolyte membrane was developed by integrating electrospun polymer nanofibers with a modified natural polymer matrix reinforced using ceramic nanofillers. The designed membrane combines the mechanical robustness of electrospun fibers with the ionic transport advantages of a biopolymer composite, resulting in improved electrolyte uptake, electrochemical stability, and interfacial compatibility with lithium metal. Electrochemical investigations demonstrated stable lithium plating/stripping behavior and reliable cycling performance in lithium-metal full cells, indicating effective dendrite suppression and enhanced cell stability. The synergistic interaction between the polymer matrix and ceramic nanofillers contributes to uniform lithium-ion transport and improved overall battery performance. This study presents an environmentally friendly strategy for designing next-generation composite polymer electrolytes and highlights the potential of natural polymer-based materials for safe, durable, and high-energy lithium-metal batteries.

ICEMSET-2026/FS/INV/125

Recent Advancements in AI-Driven Medical Disease Detection: From Deep Learning to Explainable and Multimodal Intelligence

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Abstract

Recent advancements in Artificial Intelligence (AI) have significantly improved medical disease detection by enabling accurate, rapid, and automated diagnosis from medical images, clinical data, and biosignals. This

invited talk provides an overview of emerging AI technologies, including deep learning, explainable AI, multimodal learning, and foundation models, and their applications in detecting diseases such as cancer, cardiovascular disorders, diabetic retinopathy, and neurological conditions. The session will also discuss key challenges related to data quality, interpretability, privacy, and clinical deployment, while highlighting future directions toward trustworthy and personalized AI-driven healthcare.

ICEMSET-2026/FS/INV/126

Stimuli-Responsive Tetrazole-Based Functional Metallogel for Reversible Ammonia Storage and Sensing

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Abstract

Removing toxic ammonia gas is a major challenge for sustainable chemical industries. This study introduces the first one-pot synthesis of a stable Ni(II) metallogel (Ni(II)MG) using 1,4-adiponitrile and sodium azide. The gel consists of octahedral Ni(II) coordinated to four in-situ formed CN-Tz ligands and two water molecules, exhibiting excellent mechanical strength, viscoelasticity, thixotropy, and self-healing properties. Both the metallogel and its xerogel (Ni(II)XG) enable effective ammonia sensing and reversible adsorption at ambient conditions. Its mesoporous structure and hydrogen-bonded pore water facilitate this process. Lewis acidic Ni(II) centers activate coordinated water molecules to expand the hydrogen-bonding network, promoting strong ammonia binding-a mechanism supported by DFT calculations. Ni(II)XG achieves a high ammonia adsorption capacity of 8 mmol/g (confirmed by TPD) and retains its structure over 20 cycles, offering a low-cost, sustainable, and reusable material for ammonia removal.

Keywords: Ni(II) metallogel, Ammonia sensing, Ammonia adsorption, Mechanistic investigation, Tetrazole.

ICEMSET-2026/FS/INV/127

Cyclotomic Temporal Coding for Neuromorphic Computing in GF(929): Phase-Gated Memory, Exception Dynamics, and C3 × C4 × C5 Resonance from the D12RG Monodromy-free Renormalised RCFT

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Abstract

We introduce a context-sensitive cyclotomic temporal architecture for neuromorphic computing, based on dual-coupled D12RG rings with $C_3 \times C_4 \times C_5$ resonance, with comparison to the Gang-Kim-Stubbs odd p-clock $Cp \sim= Z/pZ$, $p = 2r + 3$ with $p = 24$. Effectively, cyclotomic polynomials are a type of FPGA with arithmetic, routing and memory capabilities. The construction admits an exact GF(929) realization, 3-phase-separated read-execute-write operation, 4-phase memory read-write, 5-phase conditional exceptions, finite-control role reuse, and recursive self-regulatory feedback from Φ_{24} factorization. Neural evidence for phase-gated storage, recall, molecular gating, autonomic regulation, and five-stage corrective behaviour motivates bioelectronic and self-regulating AGI hardware. Plausible evidence has already been found in biological systems for C_4 and C_5: from this work we predict additional phase synchronicity in neural systems at C_3, C_{12} and C_{60}. Future work will demonstrate Turing-completeness.

ICEMSET-2026/FS/INV/128

Polymeric hydrogel-based nanocomposite and their biomedical applications

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Abstract

Sustainable development is one of the prime goal of the researchers all over the world. We have been synthesizing nanocomposites with agricultural waste as filler. This approach involves reduction of agricultural waste and their conversion into a biomedically useful product. We have synthesized several nanocomposites with nanocellulose, silica, fiber as filler. To achieve different properties, different polymer matrix are used. The filler provides it mechanical strength. Biomedical applications include wound healing, drug release, antibacterial and antifungal activities.

Keywords: Nanocomposite, hydrogel, biomedical, drug release, agricultural waste.

ICEMSET-2026/FS/INV/129

Electrochemical Synthesis of Nanostructured β-SiC: From Nanowire Formation to Lithium-Ion Battery Application and High-Temperature Oxidation Behaviour

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Abstract

Silicon carbide is a wide-bandgap ceramic of growing interest for electronic, energy and high-temperature structural applications, yet conventional carbothermic production is energy-intensive and yields coarse, impurity-laden powder. This talk presents a low-temperature molten-salt electrochemical route in which sintered SiO_2/graphite discs are cathodically polarised in $CaCl_2$ at 1173 K, converting the oxide/carbon precursor directly into phase-pure β-SiC nanowires (length 400-600 nm, diameter 10-40 nm) with low residual oxygen. Electrochemical testing shows the nanowires deliver a reversible lithium-storage capacity near 1000 mAh/g with coulombic efficiency above 99%, substantially exceeding graphite. In-situ high-temperature X-ray diffraction and thermal analysis further reveal that the nanowires remain stable in air to about 550 °C, oxidising thereafter via a passive, diffusion-controlled route to quartz and cristobalite while retaining an unoxidised SiC core to 1200 °C. Together, these findings establish electro-deoxidation as a scalable, single-step pathway from oxide precursor to functional SiC nanomaterial for energy-storage and high-temperature applications.

Keywords: Molten-salt electro-deoxidation, Silicon carbide nanowires, Lithium-ion battery anode, High-temperature oxidation, FFC-Cambridge process.

ICEMSET-2026/FS/INV/130

Engineering Graphene Oxide-Mesoporous Magnetite Hybrid Composites for Sustainable Water Remediation

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Abstract

Synthetic dyes present in wastewater streams from various industries such as textile, leather, printing, plastic, food and cosmetics could cause serious environmental pollutions. In this respect, the removal of dye molecules from waste water have attracted considerable attention in recent years. We report the synthesis of Graphene Oxide-mesoporous magnetite nanoparticle hybrid composite (Fe_3O_4/GO) and utilization in dye removal from aqueous media. Fe_3O_4/GO composite synthesized by one-step solvothermal route. The structural, surface and magnetic characteristic of GO and Fe_3O_4/GO were investigated by TEM, XRD, FT-IR and VSM. The spectroscopic studies reveal that the Fe_3O_4/GO nanocomposite is a highly efficient adsorbent for methylene blue

(MB) and rhodamine B (RB) from aqueous solution, providing an adsorption capacity of 17.5 and 19.3 mg/g respectively. The kinetics studies showed that the adsorption behavior of Fe_3O_4/GO fits well with the pseudo-second-order kinetic model. Moreover, it is a magnetically separable and reusable material for MB and RB removal from water, which is preserving its initial efficiency 99% and 65% respectively for RB and MB even after 7 successive runs.

Keywords: Adsorption, Rhodamine B, Methylene blue, graphene oxide, magnetic nanoparticles.

ICEMSET-2026/FS/INV/131

Studies on Rare Earth Doped Bismuth Iron Titanate

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Abstract

This talk reveals a comprehensive investigation of rare-earth ion (lanthanum, gadolinium and neodymium) substitution on the structural, dielectric, ferroelectric, and magnetic properties of bismuth iron titanate. The rare-earth ions were introduced at the bismuth-site in varying concentrations (x=0.10. 0.15 and 0.20 i.e., $Bi_{1-x}RE_xFe_{0.5}Ti_{0.5}O_3$). Structural characterization performed using X-ray diffraction confirmed the coexistence of multiple phases across all compositions. Morphological analysis, conducted via FE-SEM, confirmed the polycrystalline nature of the samples. Elemental composition was confirmed using energy-dispersive X-ray spectroscopy. Dielectric behaviour was examined over a broad frequency and temperature range using PSM. Frequency-dependent AC conductivity followed Jonscher's universal power law, and the conduction process at elevated temperatures was governed by the correlated barrier hopping (CBH) mechanism. Ferroelectric characteristics were studied using a P-E loop tracer, while room-temperature magnetic measurements were obtained using a VSM. Overall, the findings highlight the potential of these rare-earth-substituted materials for various electronic applications.

Keywords: XRD; Dielectric; AC conductivity; Ferroelectric; Magnetic.

ICEMSET-2026/FS/INV/132

Optoelectronic Laser Speckle Imaging of Molecular Dynamics During Thermal Expansion in Liquid Water

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Abstract

This study presents a low-cost optoelectronic laser speckle imaging technique for the real-time quantification of the moderate thermal expansion and contraction of liquid water. Time-resolved laser speckle patterns were recorded under coherent illumination and analyzed to generate velocity vector fields describing temperature-dependent molecular dynamics. Profile velocities at different temperatures were evaluated together with the Inertia Moment (IM) obtained from the Time History Speckle Pattern (THSP) and corresponding co-occurrence matrices (COM). The results demonstrate that profile velocity and IM are sensitive indicators of the thermal state of liquid water and effectively capture changes associated with thermal expansion. Variations in speckle grain size further reveal heat exchange between the liquid and its surroundings, enabling reliable detection even at temperatures as low as 4°C. The proposed non-invasive and cost-effective technique successfully characterizes both macroscopic flow behavior and microscopic molecular dynamics, offering a promising optical tool for thermal characterization and real-time monitoring of temperature-induced processes in liquids.

Keywords: Laser speckle; optoelectronic; liquid; molecular dynamics.

ICEMSET-2026/FS/INV/133

Conducting Polymer- Carbon Nanotube nanocomposites: A brief Overview

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Abstract

Conducting Polymers (CP), since their discovery in mid 19th century, have revolutionized the research on flexible electronic due to their fascinating properties like good electrical properties and electrochemical behavior, bio compatibility, facile synthesis process. However, conducting polymers have certain limitations which led to the development of CP nanocomposites, a new class of hybrid materials which not only improves the properties of conducting polymers but also imparts multifunctionality to the materials, as compared to conventional polymeric material. CP nanocomposites have applications in several fields like optoelectronic devices, sensors, energy storage device, biomedical applications, Electromagnetic shielding devices and so on. The different materials used for CP nanocomposite are metal and metal oxide nanoparticles and carbon-based nanoparticles like carbon nanotubes (CNT) and graphene. This article presents a comprehensive overview on Conducting polymer-Carbon nanotube nanocomposites and explores their synthesis, properties and applications as well as highlights the current challenges faced in this field.

Keywords: Conducting polymer; Carbon nanotube; nanocomposite; flexible electronics; synthesis and applications.

ICEMSET-2026/FS/INV/134

Study of a thermodynamic model that considers size and shape Effects in nanomaterials

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Abstract

The models created in this study are employed to investigate various thermodynamic properties of nanomaterials. A closer alignment between theory and experiment suggests the proposed model is valid. Because the model is simple and user-friendly, we extend the theory to explore how the thermodynamic properties of various nanomaterials vary with size and shape. The results were benchmarked against prior theoretical studies and experimental data. We have determined that the model aligns more closely with prior theoretical work and experimental studies. Present research develops thermodynamic models for the Debye frequency, melting entropy, melting enthalpy, and Einstein temperature. To the best of our knowledge, no existing literature contains models that perform well in this regard.

Keywords: Size, Shape, Nanomaterials, Melting Entropy, Melting Enthalpy.

ICEMSET-2026/FS/INV/135

Waste Glycerol-Derived Reduced Graphene Oxide as a Sustainable Green Nanomaterial for Efficient Dye Degradation and Wastewater Purification

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Abstract

The increasing discharge of synthetic dyes from textile, leather, and chemical industries has become a major environmental concern due to their persistence, toxicity, and resistance to conventional wastewater treatment methods. The development of sustainable nanomaterials from renewable resources offers a promising strategy for environmental remediation. In the present work, reduced graphene oxide (rGO) was synthesized through a

green reduction process using waste glycerol generated as a by-product of biodiesel production. This approach simultaneously valorizes industrial waste and eliminates the need for hazardous reducing agents, providing an environmentally benign route for the preparation of functional carbon nanomaterials. The synthesized waste glycerol-derived reduced graphene oxide (WG-rGO) was characterized using UV–Visible spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, X-ray Diffraction (XRD), Raman spectroscopy, and Scanning Electron Microscopy (SEM) to confirm the successful reduction of graphene oxide and restoration of its graphitic structure. The resulting material exhibited enhanced electrical conductivity, increased surface area, and abundant active sites suitable for adsorption and catalytic degradation of organic pollutants. The proposed dye degradation mechanism involves the rapid adsorption of dye molecules onto the π-conjugated surface of WG-rGO through π–π interactions and electrostatic attraction. In the presence of dissolved oxygen and appropriate irradiation or oxidizing conditions, electron transfer occurs on the conductive graphene network, promoting the formation of reactive oxygen species (ROS), including superoxide radicals ($\bullet O_2^-$), hydroxyl radicals (•OH), and singlet oxygen. These highly reactive species attack the chromophoric bonds of dye molecules, leading to successive oxidation, decolorization, ring opening, and eventual mineralization into environmentally benign products such as carbon dioxide and water. The restored sp^2 carbon network of WG-rGO facilitates efficient charge transport, suppresses electron–hole recombination, and enhances catalytic efficiency during the degradation process. This study demonstrates a sustainable approach that integrates green chemistry, waste valorization, and advanced nanotechnology for wastewater purification. Waste glycerol-derived reduced graphene oxide shows significant potential as an eco-friendly nanomaterial for dye degradation and environmental remediation, contributing to circular economy practices and sustainable water treatment technologies.

Keywords: Reduced graphene oxide; Waste glycerol; Biodiesel by-product; Green synthesis; Dye degradation; Wastewater purification; Reactive oxygen species; Environmental remediation.

ICEMSET-2026/FS/INV/136

Temperature Dependence and Performance Evaluation of Materials for Solar-Pumped and High-Power Fiber Lasers

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Abstract

Playing a vital role in the development of fiber lasers, rare-earth doped photonic materials have always been the central area of interest because of their optical performance governed by quantum efficiency and thermal behavior. To cite, the MKMS model demonstrated efficient approaches for quantum efficiency optimization, demonstrating the interests of scientific community in this field. Still, the influence of temperature on material performance remains an important theoretical challenge. In the present work, the initiative to formulate a temperature-dependent framework is considered, evaluating the performance of rare-earth doped photonic materials by correlating phonon energy, multi-phonon relaxation and radiative and non-radiative transitions. The proposed analysis aims to provide improved insight into the thermal response of laser materials and their suitability for efficient fiber laser operation. The study is expected to establish a useful theoretical basis for selecting and optimizing photonic materials for reliable, high-efficiency solar-pumped and high-power fiber laser systems.

Keywords: Rare-Earth Doped Photonic Materials; Temperature Dependence; MKMS Model; Solar-Pumped Fiber Lasers; High-Power Fiber Lasers.

ICEMSET-2026/FS/INV/137

Simultaneous Transmit and Receive (STAR) Performance of 4×4 Ring Decoupling Structure-Based Ultra-Wideband MIMO Antennas for Transceiver Applications

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Abstract

The design and performance of a compact UWB 4x4 Multiple Input Multiple Output (MIMO) antenna for transceiver applications that uses the asymmetric tilting microstrip feeding (ATMF) line and achieves a dimension of 54.9×54.9×1.6 mm^3 are discussed in this talk. The suggested antenna obtained a maximum 93.8% total efficiency, a bandwidth of about 9 GHz, isolation >20.37 dB, and a peak gain of 6.07 dB using a ring decoupling structure. After evaluation, it is determined that the simulated diversity parameters ECC, TARC, DG, CCL, and MEG are sufficient. A Simultaneous Transmit and Receive (STAR) system is created using the proposed antenna, a transmit power divider, and a receive power combiner. The channel capacity (CC) of propagation channels formed between the proposed antenna and a 4-port multi-ring MIMO antenna is determined by evaluating the path loss and signal-to-noise ratio (SNR). The maximum CC in the 3-6 GHz band is 4.63 bps/Hz for a single TX antenna, 12.75 bps/Hz for two TX antennas, 16.87 bps/Hz for three TX antennae, and 22.53 bps/Hz for four TX antennas with four RX antennas. These measurement findings indicate that the proposed antenna can be used in high-capacity wireless propagation channels.

Keywords: Diversity parameters, MIMO antenna, ultra-wideband, channel capacity, STAR application.

ICEMSET-2026/FS/INV/138

Artificial Intelligence for Low-Dose Medical Imaging: Advancing Safer and High-Quality Diagnostic Imaging

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Abstract

Computed Tomography (CT) has become an indispensable medical imaging modality due to its ability to provide high-resolution cross-sectional images of the human body, enabling accurate diagnosis and treatment planning. However, these diagnostic benefits come at the cost of exposing patients to ionizing X-ray radiation. Studies have indicated that repeated CT examinations may increase the risk of radiation-induced cancer, with CT-related radiation estimated to contribute to approximately 5% of cancer cases. Consequently, significant research efforts have been directed toward Low-Dose Computed Tomography (LDCT), which follows the ALARA (As Low As Reasonably Achievable) principle to minimize radiation exposure while preserving diagnostic image quality. The rapid advancement of Artificial Intelligence (AI) has transformed the field of low-dose imaging. Conventional image enhancement techniques based on spatial, frequency, or histogram-domain processing are increasingly being replaced by deep learning approaches. In particular, advanced U-Net-based architectures and other convolutional neural network models have demonstrated remarkable success in suppressing noise, preserving anatomical structures, and improving the diagnostic quality of LDCT images.

Keywords: Low-Dose Computed Tomography (LDCT); Artificial Intelligence; Deep Learning; ALARA; Radiation Dose Reduction.

ICEMSET-2026/FS/INV/139

Aluminum Surface-State-Driven Modeling of GEO Spacecraft Charging Using a Rectangular Canonical Cell

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Abstract

We present a computational framework for predicting spacecraft surface charging in geostationary orbit (GEO) that couples material-surface evolution, plasma interaction, and electromagnetics. A rectangular coaxial cross-section is introduced as a scalable canonical cell for systematic numerical studies. Electrostatic properties (charge distribution, capacitance) are computed using the Method of Moments (MoM) and incorporated into a charging solver driven by double-Maxwellian GEO plasma conditions. Surface emission is treated via secondary electron yield (SEY) models parametrized for Aluminum in Beginning-of-Life (BOL, oxidized) and End-of-Life (EOL, C-contaminated) states, enabling lifecycle-dependent simulations. Results quantify how geometry-controlled capacitance and SEY evolution jointly determine equilibrium potential: oxidized BOL surfaces suppress negative charging, whereas C-rich EOL surfaces enhance it. The framework highlights sensitivity of charging behavior to both plasma parameters and material-state evolution and provides a compact, physics-based computational tool for assessing ESD susceptibility and guiding materials selection and surface-treatment strategies for GEO spacecraft.

Keywords: Backscattered electron yield, electrostatic discharge, Method of Moments, secondary electron yield.

ICEMSET-2026/FS/INV/140

Low-Dimensional Nanomaterials: Bridging Advanced Technology and Dentistry

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Abstract

Low-dimensional materials, particularly two-dimensional (2D) materials such as graphene and MXenes, have emerged as a transformative class of nanomaterials due to their physical, chemical, mechanical, and thermal properties. Their thin structure provides a high surface area, electrical, thermal conductivity, and superior mechanical strength making ideal for advanced combination of dentistry and technology, with great potential in improving restorative materials, dental implants, tissue engineering, drug delivery, and antimicrobial coatings. Graphene, a single layer of carbon atoms arranged in a hexagonal lattice, is renowned for its remarkable conductivity and strength, while MXenes, a family of transition metal carbides and nitrides, offer excellent electrochemical performance and hydrophilic surfaces. These materials have shown significant potential in flexible electronics, sensors, catalysis, bioactivity, conductivity, and antibacterial performance, making them suitable for implant surface modification and biosensing applications. Future research on low-dimensional materials, drive innovations in sustainable energy, nanoelectronics, durability, biocompatible, and multifunctional dental materials.

Keywords: Graphene, Nanomaterial, dentistry, 2-D material, Biomedical.

ICEMSET-2026/FS/INV/141

Highly Flexible PVDF-MoS_2 Composites Nanogenerators for Mechanical Energy Harvesting

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Abstract

Batteries have long been viewed as the standard and efficient solution for powering electronic devices. Nevertheless, they have a limited lifespan, and their monitoring and replacement are ongoing challenges. To address this issue, researchers have focused on developing nanogenerators as a potential sustainable power source for smart devices. In this research, we have developed high-performance TENGs and PENGs using PVDF-MoS_2 composite films to harness mechanical energy. We examined the impact of different MoS2 loadings in the PVDF matrix, ranging from 5 to 15%. Our results indicated that incorporating MoS_2 improved the percentage of the crystalline β-phase, mechanical stability, and the dielectric constant. The PENG devices developed from PVDF-MoS_2 composites generated an output voltage of 10 V, while the TENG devices

produced an output voltage of 15 V. The electrical energy generated by these PENG and TENG devices can charge various capacitors, light up LEDs, and power different low-power electronic devices.

Keywords: PVDF; MoS_2; PENG; Energy harvesting, Dielectric.

ICEMSET-2026/FS/INV/142

An Approach to Upsurge the Memory Storage through Simultaneous Bit-storing Capacity of a Memristor Device

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Abstract

Memristor retains its previous resistive state and is an emerging field in memory storage applications. Additionally, memory architecture consumes comparatively less space and standby power than the conventional CMOS-based counterpart. This compactness increases for multiple pinched-hysteresis-loops (PHLs) in memristor characteristics, as evident from an empirical report for an Au/TiO_2/Ti device. Commercial models of the memristor generally do not include multiple PHLs, and the adaptability in circuit-level research is hindered. An approach is incorporated to infer the practical findings (device-level) into a simulation platform (modelling-level) in a step-by-step manner. Validation in memory architecture (circuit-level) is achieved by constructing the cell in the Cadence Virtuoso (45 nm) platform with a stepwise analysis. The potential of storing more than two bits in a single memory cell is evident, which proves the upsurge of space-efficient emerging memory technology. Further, low power consumption (28.80 μW) for a complete write-hold-read cycle supports miniaturization possibilities.

Keywords: RRAM/Memristor, one-transistor-one-memristor (1T1M), multi-level memory cell, Simmons tunnel barrier model, Cadence Virtuoso.

ICEMSET-2026/FS/INV/143

Structural and electrochemical studies on P2-Type Layered Oxides for Sustainable Sodium-Ion Batteries

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Abstract

As the need for environmentally friendly and renewable sources of energy storage keeps increasing, sodium-ion batteries (SIBs), are a better replacement for lithium-ion batteries. This paper investigates engineered P2-type cathodes which are composed of sodium-ion layered transition metal oxides obtained through compositional optimization and selective elemental doping. To verify the changes, structural and electrochemical studies such as XRD, SEM, and charge-discharge analysis are conducted respectively. Through these approaches, our results provide an increase in the battery's capacity, stability after many cycles, and better performance. The potential of these engineered P2-type cathodes that make up SIBs could be utilised for the exploration of these materials in portable electronics, electric vehicles, and utility grid systems with a cheaper and greener energy storage option.

Keywords: Sodium-Ion Batteries (SIBs); P2-Type Layered Oxide; Cathode Material Engineering; Electrochemical Performance; Sustainable Energy Storage.

ICEMSET-2026/FS/INV/144

AI-Enabled Spectrum Sensing for Next-Generation Wireless Communication

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Abstract

Cognitive Radio (CR) is an advanced wireless communication technology that improves spectrum utilization by enabling secondary users to access unused licensed frequency bands without interfering with primary users. Spectrum sensing is the core function of cognitive radio, responsible for identifying available channels for efficient communication. Traditional spectrum sensing techniques, such as energy detection and matched filtering, often face challenges in low signal-to-noise ratio (SNR) environments and dynamic wireless conditions. Artificial Intelligence (AI) enhances spectrum sensing by providing intelligent, adaptive, and data-driven decision-making capabilities. Machine learning and deep learning algorithms can accurately detect spectrum occupancy, reduce false alarms, and improve detection performance by learning complex signal patterns. Reinforcement learning further enables dynamic spectrum access through optimized channel selection. AI-based spectrum sensing supports efficient spectrum management and reliable communication in next-generation wireless networks, including 5G, 6G, and the Internet of Things (IoT). Despite challenges such as computational complexity and data requirements, AI remains a promising solution for future cognitive radio systems.

ICEMSET-2026/FS/INV/145

Smart Crop Care: An Integrated ML-Based Farm Decision Support System

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Abstract

Pre-planting farm decisions require simultaneous reasoning over soil chemistry, weather patterns, input costs, and crop health—a combination that no single existing tool addresses end-to-end. This paper describes Smart Crop Care, a machine learning system built to close that gap. Four inference modules are chained together: a Random Forest crop classifier, an Extra Trees fertilizer recommender, a ResNet50 leaf disease detector, and a cost regression model. Rather than using raw NPK values directly, we engineer macronutrient ratio features and a temperature–humidity index to better capture soil fertility balance and agro-climatic stress; this step alone improved crop classification accuracy by 5.1 percentage points over a rawinput baseline. On held-out test data, the crop classifier reached 92.3% top-1 accuracy, the fertilizer classifier 89.7%, and the disease detector 94.1%, with the cost model reporting an 11.8% mean absolute percentage error. The full pipeline produces a recommendation response in under 500 ms. What distinguishes this work from prior studies is not any individual model—each draws on established methods—but the way outputs flow between modules, so that fertilizer advice is conditioned on the predicted crop, financial projections are tied to the same crop and area, and all results feed a single field readiness score that farmers can act on directly.

Keywords: Precision Agriculture, Crop Recommendation; Random Forest, Extra Trees, ResNet50; 4Transfer Learning; Fertilizer Recommendation; Decision Support System.

ICEMSET-2026/FS/INV/146

Functionalization of Transition Metal Dichalcogenides (TMDs) for Next Generation Electronics and Energy Devices

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Abstract

Transition metal dichalcogenides (TMDs) have emerged as a versatile class of 2D materials for next-generation electronic and energy technologies owing to their unique structural, electronic, optical and mechanical properties. Unlike graphene, TMDs possess an intrinsic and tunable bandgap, high on/off current ratios and enhanced optoelectronic performance. However, the practical implementation of pristine TMDs is often constrained by inadequate active surface sites, relatively low electrical conductivity, environmental instability and interfacial charge-transfer limitations. To address these challenges, extensive research has focused on functionalization strategies. The functionalization of TMDs may be accomplished by covalent methods or by noncovalent methods or by metal nanoparticles. It may result surface modification, defect engineering,

heteroatom doping, phase engineering and polymer integration. The functionalization of TMDs effectively tailor the electronic structure, optimize carrier transport, improve catalytic activity and enhance the physicochemical properties of TMDs, thereby expanding their functionality across a wide range of device platforms.

Keywords: Transition metal dichalcogenides; Functionalization; Next Generation Electronics; Energy Devices.

ICEMSET-2026/FS/INV/147

An Empirical Comparison of ML Algorithms with Deep Learning-Based Optimization for Predictive Maintenance

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Abstract

Predictive maintenance performs a indispensible role in modern industrial systems by providing early fault detection and reducing unexpected downtime. This study presents a comparative analysis of various machine learning (ML) algorithms and analyses the enhancement of performance metrics through deep learning techniques for predictive maintenance applications. Initially, multiple ML models, including Logistic Regression, Support Vector Machine, Random Forest, and Decision Tree, are implemented using sensor-based operational data to predict uncertainty of equipment failure. Extensive pre-processing and feature engineering are performed to improve data quality and model robustness. The ML models are assessed using standard performance metrics such as accuracy, precision, recall, F1-score, and RMSE.

Keywords: Predictive Maintainance, Machine Learning, Deep Learning, RMSE, F1-Score.

ICEMSET-2026/FS/INV/148

Pioneering Future Electronics: Transforming Hardware Design and Autonomous Operations via Generative and Agentic AI

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Abstract

Agentic AI refers to the new form of Artificial Intelligence systems that are truly autonomous and can engage in processes of thinking and planning without human support. Today's world is characterized by a significant shift in the field of electronics amidst the development of AI technology. In contrast to standard electronics that were obliged to follow strict logic and fixed rules, Generative and Agentic AI create a new era of autonomous systems represented by self-optimizing and adaptive electronic devices. The current presentation demonstrates how Gen AI and Agentic AI bring about changes in electronic design processes, management time in the system, and hardware-software interaction. Generative AI uses cutting-edge neural modeling and multi-media models to enhance complex processes of hardware development such as VHDL coding, VLSI floorplan optimization, and semiconductor chip design. Moving beyond mechanical performance implementation, Agentic AI allows acquiring real-time decision-making through the combination of goal setting, remembering the information, reflecting, and performing the tasks. Agentic systems carry out real-time edge computing, power grid balancing, smart signal processing, and self-healing embedded centers in the Internet of Things.

Keywords: Agentic AI, Generative AI, Autonomous Electronics, VLSI Optimization, Embedded Systems, IoT, Adaptive Systems.

ICEMSET-2026/FS/INV/149

Integration of Robots in the Semiconductor Industry

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Abstract

Now a days Government of India is focusing on the advancement of semiconductor industry. In semiconductor industry many fundamental task like fabrication, testing, manufacturing is done by robots more precisely and accurately in a cost effective way. Robots are used for wafer handling, material transport, packaging and testing. The mobile robots are also used for monitoring the functioning of many instruments, machinery used in the industry. The robots have the ability to perform the repetitive tasks accurately with out significant intervention of human. The mobile robots provides the surveillance and performs the rescue operations after an accident in places where human can not reach. Many research has been conducted for designing the efficient algorithms for routing, visiting, exploration of mobile agents by a graph where the environment is represented as a graph. With the integration of machine learning, artificial intelligence with robotics transforming the semiconductor manufacturing to a greater intelligence level. Even if with many advantages it has many challenges such as cost, maintenance and complexity of integration. There are many open problems in this where researchers can work to automated the testing, fabrication, optimization of task in semiconductor industry.

ICEMSET-2026/FS/INV/150

Recent Progress in MOF Engineering for Photocatalysis and Energy Storage Applications

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Abstract

Metal organic frameworks (MOFs) have gained scientific interest in the past decade and won the Nobel Prize 2025 owing to the multitude properties displayed by these coordinated organo-metallic materials. MOFs are precisely tunable and possess high porosity and surface area due to which the avenues of its applications open from photocatalysis, energy storage devices, sensors, biomaterials, to separation technology. A significant development in the utilization of MOFs is by combining it with other materials or by converting the parent MOF into its derivatives. In the present work, the synthesis of a wide range of MOFs, such as Zn, Mn, Cu, Co, and their combination-based MOFs, will be described and their application in photocatalysis and supercapacitor devices will be elucidated. The talk will critically assess the merits and demerits providing useful insights into material properties and its effect on the device output. A unique assessment of developing hierarchical structures will be described and ways to enhance the electrochemical activity will be discussed.

Keywords: Metal organic frameworks; photocatalysis; supercapacitors; electrochemical electrodes; resistive switching memory devices.

ICEMSET-2026/FS/INV/151

Development of an Index Finger Exoskeleton for Rehabilitation

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Abstract

Hand rehabilitation plays a vital role in regaining finger mobility and hand function after neurological injury or disease. Recently, finger exoskeletons have gained attention as assistive rehabilitation devices as they provide controlled, repetitive movements that support recovery. This work focuses on development of an index finger exoskeleton for rehabilitation. A gear-based transmission mechanism, driven by an MG90S servo motor, was

developed to generate finger motion. The mechanism was fabricated using Polylactic Acid through Fused Deposition Modelling. A Fuzzy-PID control algorithm was implemented to regulate finger movement by continuously comparing the desired finger position with the measured position using two MPU6050 inertial measurement sensors. An ESP32 microcontroller was used for sensor data acquisition, control calculations, and motor actuation. All the components were assembled into a wearable index finger exoskeleton and experimentally tested on a healthy subject for its capability of assisting the index finger during flexion and extension movements.

Keywords: Hand Rehabilitation; Finger mobility; Exoskeleton; Neorological Injury; Control Algorithm.

ICEMSET-2026/FS/INV/152

Next-Generation Public Key Infrastructure: An Integrated Multi-Layer Trust Framework for Heterogeneous Electronic, Edge and Cloud Devices

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Abstract

Today's connected digital technology ranges from tiny microchips in smart devices to large cloud and edge networks. All these systems need strong security to ensure they can trust one another. These need strong digital security before sharing data across network. Without this built-in trust these online services and every day's smart devices will not be able to communicate safely. Digital security relies on a system called Public Key Infrastructure (PKI) and it uses trusted middle-men Certificate Authorities, to verify identities and keep data secret. It is still the main method used across the internet today. But traditional PKI has a hard time keeping up with newer technology. Newer technology uses small microchips and smart devices and these have not enough processing power or memory to handle data. Cloud systems and edge networks also face difficulties to run standard PKI efficiently. Smart devices containing small microchips do not have enough processing power to handle heavy security checks. Older methods used to cancel compromised certificates are very slow. The system depends on a few central authorities to maintain trust and if these main authorities are compromised, it puts the entire network at risk. In this paper, to fix these problems, a new 4-layer security system framework is suggested. This framework connects physical microchip security directly with large business software and cloud networks. The proposed framework is organized into four layers. First layer is Core Hierarchical PKI Layer and is used to issue and revoke certificates. Second layer is Cross-domain layer and it is used to allow different networks and groups to trust each other. Third layer is Automated certificate Layer and it is used to create short lived certificates which are valid only for small time period. Last layer is Decentralized Verification Layer and it is used to record the certificates related activities. We also suggest combining physical security chips with temporary digital certificates. These can safely store security keys right on the device. Using short-lived certificates means small devices don't need high processing power and need only small memory. This will keep entire system safe while working on low-power chips. This combined approach creates a lightweight security system that easily grows with organizational needs. It makes managing digital trust simple and reliable for both future microchips and complex electronic networks.

ICEMSET-2026/FS/INV/153

Hybrid Bioactive Scaffolds Based on Quinoxaline-β-Lactam Spiranes: Synthesis, Fluorescence-Assisted Binding Assays, and Computational Elucidation of Topoisomerase Interactions

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Abstract

Novel spiro quinoxaline-β-lactam-based heterocyclic spiranes were synthesized and characterized using spectroscopic techniques. Their biomolecular interactions were investigated through spectroscopic analyses and molecular docking studies. DNA-binding experiments revealed a partial intercalative binding mode with

intrinsic binding constants (K_b) ranging from 0.24-0.64 × 10^5 M^{-1}, while protein-binding studies showed moderate affinity with K_b values of 0.030-1.571 × 10^4 M^{-1}. The synthesized compounds exhibited promising antibacterial activity against two Gram-positive and three Gram-negative bacterial strains, with minimum inhibitory concentration (MIC) values between 95 and 255 µM. Preliminary cytotoxicity assessment using the brine shrimp lethality assay demonstrated significant activity, with LC_{50} values ranging from 4.00 to 12.89 µg/mL. The combined experimental and computational findings highlight the potential of these spiro quinoxaline-β-lactam derivatives as promising lead molecules for future therapeutic development and demonstrate the value of integrating synthetic chemistry with biomolecular and computational studies in drug discovery.

Keywords: Heterocyclic Spiranes; Biomaterials; Fluorescence; Computational Studies; Cytotoxicity Assay.

ICEMSET-2026/FS/INV/154

A Review of Plant Organs as Biomass Precursors for Supercapacitor Electrode Material

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Abstract

In recent years, plant based green synthesis technique has emerged as a sustainable, cost effective and ecofriendly technique for producing high-performance supercapacitor electrodes. The choice of electrode material is a chief parameter, as it plays a key role in cost efficiency, cycle life and electrochemical performance of of the device. This review provides a comprehensive comparative analysis of utilizing extracts from different plant organs as reducing and stabilizing agent in electrode material fabrication. Specifically, this report focusses on how different phytochemicals such as flavoids, polyphenols, tannins, etc act as natural bio-reductants to change surface morphology and tune electrochemical properties. Furthermore, this work correlates specific plant organ with the device performance- charge discharge rate, specific capacitance, cyclic stability, ESR (Equal Series resistance) etc. Finally, we address the challenges in reproducibility, scalability and environment impact, offering a strategic roadmap for the standardization and enhancement of plant-based energy storage devices.

Keywords: Green synthesis; supercapacitor; electrochemical; ESR; capacitance.

ICEMSET-2026/FS/INV/155

Experimental Verification of Half-Wave and Full-Wave Precision Rectifiers Using the LM358P Operational Amplifier over a 25 mV-11 V Input Range

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Abstract

Conventional rectifiers using semiconductor diodes cannot rectify low-amplitude signals. The forward voltage drop of the diode creates a dead zone near the zero-crossing point. In this work, we have implemented and experimentally verified half-wave and full-wave precision rectifier circuits using the LM358P operational amplifier and 1N4148 diodes. The circuits were assembled on a breadboard and operated with a dual power supply of ±11.7 V. A sinusoidal input of 20 Hz was applied, and its amplitude was varied from 25 mV to 11 V. The input and output waveforms were recorded on a Keysight EDUX1052A digital storage oscilloscope. Both circuits rectified accurately over the entire range, with no dead zone discernible even at the lowest amplitude of 25 mV. Hence, the diode threshold voltage was effectively compensated. The full-wave circuit gave a continuous unipolar output at twice the input frequency. The present setup will be extended to frequency-response and load-variation studies.

Keywords: Precision rectifier; Operational amplifier; LM358P; Low-signal rectification; Analogue signal conditioning.

ICEMSET-2026/FS/INV/156

Morphological and Optical tailoring of ZnSe nanocrystals through CTAB and EDTA surfactants

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Abstract

ZnSe is a direct bandgap polycrystalline II-VI group semiconductor material, known for its significant potential in optoelectronics and photocatalytic applications. The present study focuses on the influence of two surfactants – Ethylene-diamine-tetraacetic acid (EDTA) and Cetyl-trimethyl-ammonium-bromide (CTAB) on ZnSe nanocrystals synthesised via the hydrothermal method. A comprehensive analysis of the structural, morphological and optical properties has been conducted using X-ray diffraction technique (XRD), Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy, transmission electron microscopy, energy dispersive X-ray technique, UV-Visible spectroscopy and photoluminescence spectroscopy. The XRD and FTIR results confirmed the formation of ZnSe nanocrystals having a cubic structure with crystallite sizes of 27 ± 0.82 and 10 ± 0.96 nm for CTAB and EDTA-capped ZnSe, respectively. PL spectra exhibited distinct emission in the visible region. The study highlights the role of surfactants in modulating the properties of ZnSe nanocrystals.

Keywords: ZnSe Nanocrystal, Photoluminescence, Capping Agents.

ICEMSET-2026/FS/INV/157

Design and Analysis of Multilayer Reversible Dual 2-Input Xor Gate with Enable (Word Line Controlled) by Quantum-Cellular-Automata Spin Technology

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Abstract

Memory is an important storage component of any digital sequential circuit of this modern digital world and in this era, the density-reduction of any integrated circuit becomes a vital challenge. Thus, the requirement of an advance memory feature with good scalability becomes very challenging object like as other advanced component of any digital chip design in this present era. To achieve this technical advancement in memory design world, implementation of advance and novel configurations of different parts is a vital thing. A word-line controlled XOR gate has a major application for some well-known memories' architecture design like "SRAM", "ReRAM" and "DRAM". Hence, a novel design of "Dual 2-Input XOR Gate with Enable (Word Line Controlled)" is the primary approach of this work, where hybrid reversibility is applied in a multilayer optimized technical field named as Quan as "Quantum-Dot Cellular Automata" or "QCA". Low-power high-speed spintronic-electron based proposed "QCA" is an effective replacement of today's widely used "CMOS" circuitry is presented in this paper to achieve optimized parametric values with efficient unit-area based multilayer-complexity, proper output-strength and temperature-tolerance. The main purpose of this work is to bring structural improvement of the proposed digital component, which can use a vital portion of memory design. Thus, this improvement also relates to get an advanced implementation of IoT and AI component parts. To present a clear technical betterment, a comparison between two advanced technologies: "CMOS" and "QCA" is also reflected in this paper by using "CMOS" transistor based "Xilinx" and quantum cell based "QCA-Designer" (used for power-dissipation calculation) simulators. A novel work on the effect of layer-separation-gap reduction in multilayer "QCA" based proposed circuitry is also shown in this paper with proper validation of outputs. The "Spartan 3E" FPGA-Board is utilized in this work-done for output-validity-checking of the proposed design.

Keywords: Word-line controlled XOR Gate, Compute-In-Memory (CIM), Progress-In-Memory (PIM), QCA, Hybrid-Reversibility, FPGA.

ICEMSET-2026/FS/INV/158

Reactionless engines for outer space travel from inertia violation with a new design electromagnetic railgun

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Abstract

A new design (low voltage, heavy armature, low resistance) electromagnetic railgun invented by the author has shown a new physics effect – the so-called Lorentz force does not have an equal and opposite reaction. This paper describes the experiment showing inertia violation, with detailed analysis below. https://groups.google.com/g/sci.physics/c/VtFeGAkIABg/m/CLPzLRElAwAJ This effect – a discovery as important as the wheel, electricity, radioactivity - can be used to create spaceships travelling at faster-than-light speeds, for travel to the stars. Physics is updated accordingly, as shown in the links provided in https://groups.google.com/g/sci.physics/c/JX4NuIRZSa4. Concepts like entropy, relativity, quantum, etc. are debunked as a consequence of this experiment. Aether gets re-established as the key component of the infinite and hence eternal universe supporting all radiation; energy is continually created and destroyed; all forces including gravity are electric; the cores of the stars and planets are very cold to support the superconducting currents forming their undisputed magnetic fields.

Keywords: Inertia violation, reactionless engines, updated physics.

ICEMSET-2026/FS/INV/159

Dual-Mode Near-Infrared (NIR) Chemosensors for Sensing Applications

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Abstract

Multifunctional chemosensors constitute a versatile and powerful class of molecular tools capable of detecting a broad spectrum of targets, ranging from biologically relevant cations, anions, and reactive species to complex biomacromolecules such as DNA, proteins, and enzymes. These systems operate through diverse mechanisms, including chemodosimetric reactions, coordination-based recognition, and specific binding interactions. Our research focuses on designing advanced chemosensors supported by theoretical studies to elucidate receptor–analyte interactions, as well as developing water-soluble NIR fluorescent ligands for selective biomolecular detection through groove binding, intercalation, and end-stacking modes. Furthermore, these sensing capabilities are translated into practical platforms by engineering 3D-printed devices functionalized with fluorescent probes, enabling rapid, sensitive, and cost-effective colorimetric and fluorometric detection. These devices are further enhanced with smartphone-based readout systems to facilitate on-site environmental and analytical applications.

Keywords: Multifunctional; Dual-mode; Chemosensors; NIR; Device.

ICEMSET-2026/FS/INV/161

Study of Various Propagation Dynamics of Soft-Glass Based Optical Fibers for Near- and Mid-Infrared Applications

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Abstract

Nowadays, soft-glass based optical fibers are drawing huge attention in the field of optics and photonics due to their broad infrared transparency, greater optical nonlinearity and controllable dispersion characteristics. Recently, we have designed and optimized the germanate–tellurite composite optical fibers for applications in the near- and mid-infrared regions utilizing the finite-difference numerical approach. The study demonstrates

that by tailoring the core radius and refractive index profiles, one can achieve flattened near-zero dispersion region and controllable zero dispersion wavelength in that composite fibers. These fibers have potential applications in four-wave mixing, supercontinuum generation and other nonlinear optical processes. The presentation will briefly highlight the works on specialty optical fibers for near- and mid-infrared photonic applications.

ICEMSET-2026/FS/INV/162

Early Detection of β-amyloid (Aβ) by Nano-Field Effect Transistor-Recent Advances and Future Perspectives

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Abstract

Early detection of β-amyloid (Aβ) biomarker is important for the diagnosis and therapeutic approach of Alzheimer's disease (AD). In this context, label-free, rapid and highly sensitive detection of Aβ with its two types such as $A\beta_{40}$ and $A\beta_{42}$ are highly demanding for rapid intervention in slow progress of AD. Field-effect transistor (FET)-based biosensors have appeared as competent platforms for effective and precise detection of Aβ biomarkers. This review highlights recent advances in FET biosensors employing graphene, Si nanowires, CNT, and 2D semiconductors for Aβ detection. Various transduction elements, such as antibodies, aptamers, and peptide probes, are deliberated in context of sensitivity, selectivity, and detection limits. The prime challenges of the sensor such as Debye screening, device reproducibility, and clinical translation are critically examined, along with possible solutions covering surface engineering, microfluidics, and AI-assisted signal processing. The review establishes the potential of FET biosensors as next-generation point-of-care (POC) diagnostic tools for early AD detection and personalized healthcare applications.

Keywords: β-amyloid (Aβ); FET-Based biosensor; graphene; microfluidics; Artificial Intelligence.

ICEMSET-2026/FS/INV/163

Radiation-Matter Interactions in Bismuth-based Glasses and Polymers: A Multi-Parameter Computational Approach

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Abstract

The computation of radiation interaction parameters is fundamental to radiological science, enabling accurate prediction of radiation behavior in materials. Key parameter including mass attenuation coefficient (MAC), half value layer (HVL), mean free path (MFP), exposure buildup factor (EBF), and fast neutron removal cross-sections (FNRC) quantify radiation attenuation and scattering. A computational approach integrating XCOM, XMuDat, ESTAR, and GP-fitting methods to evaluate these essential radiation interaction parameters across diverse materials is presented. Applied to some bismuth-based glass systems (bismuth-modified lithium zinc borate glasses, calcium–potassium phosphate glasses, and bismuth-lithium-cerium-molybdenum-borate glasses) and polymers (PVDC, PES), our approach generates over 100,000 data points per sample across continuous energy ranges. Results demonstrate excellent agreement between theoretical and experimental values, validating our methodology for gamma, neutron, and charged-particle shielding. This multi-parameter approach supports applications in medical imaging, radiation therapy, and nuclear safety, offering a robust tool for designing next-generation radiation-resistant technologies.

Keywords: Radiation interaction parameters; bismuth-based glasses; polymers; half value layer; charged-particle shielding.

ICEMSET-2026/FS/INV/164

From Design to Application: Advances in Tunnel Field-Effect Transistors

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Abstract

The relentless scaling of conventional CMOS technology poses significant obstacles in terms of power consumption and subthreshold barriers. Tunnel Field-Effect Transistors (TFETs) have emerged as viable alternatives for ultra-low power applications due to their ability to produce subthreshold swing below the thermionic limit via band-to-band tunneling. The talk highlights current breakthroughs in TFET design, focusing on double-gate PNPN structures and performance enhancement using strategies such as Ge-source integration, expanded source configurations, and doping engineering. The impact of interface traps and temperature variations, as well as key device parameters such as ON/OFF current ratio, subthreshold oscillation, and analog performance, are assessed using simulation-based analysis. TFETs exhibit significant potential in high-sensitivity biosensors, as they are capable of label-free detection as a result of their improved sensitivity to surface charge fluctuations, in addition to their use in switching applications. AI-driven methods are additionally highlighted as a potential path forward for effective device optimization and predictive modeling. These developments make TFETs essential for the development of low-power electronics of the future, biosensing systems, and energy-efficient computer applications.

Keywords: Tunnel Field Effect Transistor (TFET); Subthreshold swing; Trap; Biosensor; Sensitivity.

ICEMSET-2026/FS/INV/165

Recent Trends in M-Type Hexaferrites as Magnetic Semiconductor Materials: Properties, Synthesis, and Emerging Applications

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Abstract

Strontium hexaferrite, an important M-type hexaferrite and magnetic semiconductor material, has attracted significant attention due to its excellent ferrimagnetic, electrical, dielectric, and optical characteristics, enabling its potential use in permanent magnets, microwave components, electromagnetic interference shielding, sensors, and photocatalytic systems. In this study, the effect of dopant incorporation on the multifunctional properties of strontium hexaferrite ceramics synthesized through the conventional ceramic method was systematically investigated. The structural, morphological, optical, electrical, dielectric, and magnetic properties were analyzed using X-ray diffraction (XRD), scanning electron microscopy (SEM), diffuse reflectance spectroscopy (DRS), complex impedance spectroscopy, and vibrating sample magnetometry (VSM). Rietveld refinement confirmed the formation of a single-phase magnetoplumbite-type hexagonal structure with the $P6_3/mmc$ space group for all compositions. Dopant substitution influenced grain growth, microstructural evolution, and optical bandgap tuning while maintaining structural stability. Electrical investigations based on impedance spectroscopy and electric modulus analysis revealed the contributions of grain and grain boundary effects, reduced interfacial polarization, and charge transport behavior, which were explained using an equivalent circuit model. Temperature-dependent dielectric analysis exhibited characteristic dielectric transitions associated with dipolar relaxation and dielectric phase transformation. The AC conductivity behavior followed Jonscher's universal power law and the random free energy barrier model, indicating enhanced charge transport through electronic conduction and large-polaron hopping mechanisms. Magnetic studies demonstrated a transition from hard to soft magnetic characteristics with enhanced saturation magnetization and reduced coercivity, highlighting the potential of doped $SrFe_{12}O_{19}$ ceramics as multifunctional magnetic semiconductor materials for advanced electronic and magnetic applications.

Keywords: Strontium hexaferrite; Magnetic semiconductor; Magnetoplumbite structure; Impedance spectroscopy; Electrical conduction mechanism; Dielectric transition; Magnetic properties; Multifunctional ceramics.

ICEMSET-2026/FS/INV/166

Phyto-Assisted Synthesis of Silver Nanoparticles and Formulation of Antifungal Herbal Cream: A Synergistic Approach Using *Azadirachta Indica* and *Delonix Regia*

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Abstract

Nanoparticles like silver are attracting attention because of their special qualities and functions, including fungicidal, bactericidal, antioxidant, and anticancer effects. Nanotechnology is a fast expanding subject. Because of multidrug resistance to existing therapies, silver has drawn interest as an antibacterial agent. The "GREEN" synthesis of metallic nanoparticles has drawn interest since it is inexpensive, toxic-free, and an eco-friendly alternative. . Assessing the synergistic impact of extracts from Azadirachta indica and Delonix regia on the production of silver nanoparticles is the goal. Fourier transform infrared spectrophotometers, TEM, UV spectrophotometers, and particle size analyzers were among the tools used to characterize the produced silver nanoparticles. Using the 96 Well Dilution technique, the MIC of silver nanoparticles was determined to be 31.2 µg/mL. The herbal antifungal cream, which is made with silver nanoparticles and other extracts, has high thermal stability up to 60–110°C and is intended to work in concert to increase its effectiveness in avoiding antimicrobial resistance. This novel strategy reduces the possibility of germs becoming resistant over time while also more successfully combating fungal diseases. Future research will concentrate on maximizing each ingredient's concentration to improve the cream's effectiveness while maintaining its gentleness on the skin.

Keywords: Nanoparticles, Eco engineered, Antifungal cream, *Candida albicans*, Phytochemicals.

ICEMSET-2026/FS/INV/167

Tailoring Electrical Percolation and Emergent Inductance in PVdF/CNT Nanocomposites for Multifunctional Technologies

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Abstract

Flexible polymer nanocomposites with tunable electromagnetic behavior offer groundbreaking potential across advanced electronics, energy storage, and defense platforms. This invited talk presents the fabrication and electromechanical characterization of polyvinylidene fluoride (PVdF)–carbon nanotube (CNT) nanocomposites (0–4 wt%) synthesized via mechanical mixing. We highlight a sharp insulator-to-conductor transition at 1 wt% CNT loading, where electrical conductivity surges by four to five orders of magnitude, signaling the formation of a robust percolated network. Crucially, series RL circuit analysis and Lissajous pattern characterizations reveal an unexpected transition to inductive behavior beyond 1 wt% filler concentration. This emergent inductive dynamic, coupled with enhanced conductivity, unlocks key pathways for high-performance radar-absorbing materials (RAMs), EMI shielding, biomedical hyperthermia, MRI contrast agents, and soft actuators. We will examine the core physical mechanisms driving this dual conductive-inductive behavior and discuss strategies for deploying these multifunctional materials in next-generation technologies.

Keywords: Polyvinylidene Fluoride (PVdF); Carbon Nanotubes (CNTs); Percolation Threshold, Inductive Behavior; Multifunctional Nanocomposites; Radar Absorbing Materials (RAMs).

ICEMSET-2026/FS/INV/168

Ultra-Sensitive Electrochemical Sensing of Biomolecules via Surface-Engineered Electrodes

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Abstract

Electrochemical sensors offer rapid, cost-effective, and highly sensitive platforms for detecting vital biomolecules like dopamine, serotonin, and ascorbic acid, which are crucial for diagnosing neurological and physiological disorders. Recent advancements emphasize modifying accessible substrates—particularly low-cost pencil graphite electrodes (PGEs) and gold surfaces—with engineered nanomaterials. Strategies utilizing carboxylated MoS_2 conjugates, amorphous carbon, carbon soot, and alkaline etching significantly enhance the electrocatalytic activity and electroactive surface area of the sensors. Consequently, these modified electrodes achieve ultra-low limits of detection, scaling from nanomolar down to femtomolar levels (e.g., 3.98 fM for dopamine and 12.04 fM for serotonin) across wide dynamic ranges. Furthermore, these platforms demonstrate exceptional selectivity against common interfering biomolecules, alongside high reproducibility and long-term stability. By combining scalable materials with robust voltammetric techniques, these advanced electrochemical systems provide a powerful, label-free approach for early clinical diagnostics and routine biomolecules monitoring.

ICEMSET-2026/FS/INV/171

Smart and Intelligent Technologies in Residential Buildings, Case of NCR, India: A Framework for Sustainable, Adaptive, and People-Centric Healthy Living

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Abstract

The exorbitant advancement of digital & electronic technologies has transformed conventional residential buildings into intelligent & smart living spaces rather an environment designed for enhancing occupants' quality of life, its comfort levels, sense of safety & security, cutting electricity bills by improving energy efficiency, leading to better &healthy living conditions. Smart and intelligent residential buildings very efficiently integrate Internet of Things (IoT). House hold equipments, various domestic devices, Artificial Intelligence (AI), Machine Learning (ML), Building Information Modelling (BIM), cloud computing, digital twins, advanced sensors, and automated building management systems to create energy efficient adaptive and responsive indoor & outdoor environments. These technologies enable to develop updated data, real-time monitoring of internal environment and help in managing intelligent control of temperature, lighting, HVAC systems, security, water management, indoor air quality, and energy consumption while supporting predictive maintenance and optimized resource utilization. This paper is an attempt to review the major available economical smart and intelligent technologies currently used and employed in residential buildings in NCR Region in India and examines their use pattern, effectiveness, contribution to sustainable development and resilient urban Indian living. It studies & analyses the role of intelligent decision-support systems, renewable energy integration, smart grids, energy storage, occupancy-based automation, voice-assisted control, and data-driven building performance optimization viz-a-viz nurturing traditional environment. The study further discusses use of emerging concepts in residential buildings technologies such as digital twins, edge computing, blockchain-enabled security, and human-centric design for future smart homes as these technologies are used in NCR Region. Also, a study has been made to analyses the effects on costing & and additional expenditure incurred while establishing these technologies in Indian NCR Located homes, understanding of these technologies to general people and people's perception about these technologies. The paper also proposes a comprehensive conceptual framework in context to middle class people NCR locates residences that integrates technological, environmental, economic, and social dimensions for developing intelligent residential buildings. It also identifies key implementation challenges, including costing, interoperability, cybersecurity, privacy protection,

high initial investment, data governance, and user acceptance etc. The findings suggest that the successful integration of smart and intelligent technologies can be highly effective to reduce operational energy consumption, security, improve occupant health and comfort, enhance building resilience, and contribute towards achieving the Sustainable Development Goals (SDGs) and net-zero carbon objectives. Also, these technologies are easy to use, user friendly and should be integrated at the initial stage of design, so that the same can be incorporated from the conceptual to construction stage and during use. The study provides useful insights, information for common people. Designers' architects, planners, engineers, policymakers, and researchers involved in the design and development of next-generation intelligent residential environments.

Keywords: Smart & Green Residential Buildings, Intelligent Buildings, Internet of Things (IoT), Artificial Intelligence, Building Automation, Digital Twin, Smart Home, Building Information Modelling (BIM), Energy Efficiency, Sustainable Housing.

ICEMSET-2026/FS/INV/172

Laws of Optics in the Framework of the Tachyon Model of the Photon Structure

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Abstract

The analysis of the interaction of physical bodies in time is based on the uniformity of spatial and temporal coordinates. The analysis leads to the conclusion that charge is not a property of particles, but a particle with an imaginary value of mass, moving at a speed exceeding the speed of light (tachyon). Two oppositely charged tachyons form a dipole, a stable balanced system (photon). The average value of the projection of the tachyon velocity on the direction of travel corresponds to the speed of light. The dipole structure of the photon explains the laws of reflection and refraction of light. The reflection of light from the flat polished surface of the metal is determined by the interaction of the photon dipole and the surface charge of the electron layer. The refraction of light in the dielectric layer is caused by the interaction of the photon dipole with the dipoles of molecules. As a result, the path of the photon is lengthened, and, accordingly, the time of its movement inside the dielectric increases, which gives rise to the classical illusion of a decrease in the speed of light in a dielectric. A series of photons move in the surface layer of the dielectric along the paths leading to the input plane, resulting in a partial reflection of the light flux.

ICEMSET-2026/FS/INV/173

Exploring the Photovoltaic Potential of $CsSnI_3$: Electronic and Optical Insights from First Principles

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Abstract

The use of lead-free halide perovskites as materials for sustainable photovoltaic applications has emerged as promising. In this work, the electronic, optical and photovoltaic properties of the all-inorganic $CsSnI_3$ are explored using first-principles density functional theory (DFT) calculations at the GGA-PBE level. The band structure calculated shows its semiconducting nature with a band gap of 0.852 eV. Based on the density-of-states analysis, the band-edge states are mainly controlled by the Sn–I framework, and the main contributions to the valence and conduction bands are from I and Sn, respectively. $CsSnI_3$ has strong optical absorption (of the order of 105 cm-1), with moderate reflectivity, which suggests an efficient light harvesting capability. The optical response calculated for a 400 nm absorber layer is 23.04 mA/cm², 0.867 fill factor and 17.01% power conversion efficiency. The results indicate that CsSnI3 is a potential absorber material for PV application without the use of lead.

Keywords: Lead-free perovskite, GGA-PBE, Electronic Properties, Optical Properties, Photovoltaics.

ICEMSET-2026/FS/INV/174

Multifunctional Magnetic Polymer Composites for Electromagnetic Management in Next-Generation Electronics

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Abstract

The widespread and accelerating usage of electronic devices has significantly raised the radiation levels, causing complex electromagnetic interactions. This leads to electromagnetic smog, which involves the risk of corrupting crucial signals, threatening the efficient functioning of sensitive electronics in safety-critical and high-performance applications such as healthcare, aerospace, and defence. This expedites the demand for the development of versatile electromagnetic interference shields that are flexible and lightweight. As the conventional metal shields have several limitations, novel polymer-based composite films are one of the adaptable and efficient solutions. Amongst all, multi-functional composites consisting of magnetic, conducting, and dielectric characteristics are found to be the most efficient due to their synergistic interactions. This talk focuses on our research on the design and study of various multifunctional materials for electromagnetic interference (EMI) shielding applications in the X-band frequency region. Our research group has achieved the curbing of microwave transmission to an extent of 0.001%. This talk also aims at discussing the emerging strategies involved in the achievement of multifunctional composite systems that exhibit superior EMI shielding effectiveness. Furthermore, the development of next-generation smart EMI shields with additional functionalities holds significant promise in sustainable energy storage and wearable electronic applications.

Keywords: Electromagnetic management; Conducting particles; Magnetic composites; Dielectric Polymers; Multifunctional EMI shields.

ICEMSET-2026/FS/INV/175

Metal Chalcogenide -Plasmonic Nanoparticles Embedded in Stable Polymer Matrix for Ballast Water Treatment

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Abstract

β – In_2S_3 semiconductor quantum dots that belongs to the III-VI group having a tunable energy band, exhibiting high absorption and luminescence in the visible-region of the electromagnetic spectrum. The incorporation of plasmonic nanostructures enhances the light harvesting capabilities and reduced treatment time arising from the exciton-plasmon interactions. The plausible mechanism for disinfection shows a major contribution from the conduction band electrons which reacts with water molecules to generate hydroperoxyl radicals and later stable hydrogen peroxide that oxidizes the cell membranes of the micro-organisms. The microbial disinfection kinetics is studied using UV-Transmittance at 254 nm and is confirmed using the standard plate-count technique. The studies show that there is complete disinfection attained within a time of 90 minutes and accompanied with no regrowth is observed in 30 days. This photocatalyst is also found to attain 95% disinfection up to 3 cycles of treatment and has a shelf-life of one year with changes in bandgap recorded as ~ 0.14 eV over the period.

Keywords: Ballast Water Treatment; Catalysis; Indium Sulphides; Nafion; Disinfection.

ICEMSET-2026/FS/INV/176

Development and Numerical Investigation of an Acoustic Levitation System

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Abstract

Acoustic levitation is the manipulation and stable suspension of particles by ultrasonic standing waves without contact with the particles. The acoustic levitation system has been developed and investigated numerically using the finite element method (FEM) simulation in COMSOL Multiphysics. Computer-Aided Design (CAD) software was used for the system geometry design and analysed to investigate the acoustic pressure field in the levitation cavity. The results of the frequency domain simulations indicated that the system at 58 kHz exhibits a stable standing-wave field with clearly defined pressure nodes, which is well suited for particle levitation. To maximize the acoustic radiation force, a parametric optimization was carried out, changing the main design parameters such as the inter-transducer distance and the geometry of the cavity. The optimized configuration yielded a trapping force for the acoustic radiation, about 27 times larger than the gravitational force on the levitated particle, resulting in a strong trapping force and improved stability. Rapid convergence of the particles to stable equilibrium positions with damped oscillations was obtained from transient particle-tracing simulations including the gravitational and aerodynamic drag forces. The study also determined the system's operational envelope with increased amplitude of excitation, when nonlinear acoustic effects become important which destabilize the particles. The numerical results can serve as useful guidelines for designing, optimizing, and future experimental implementation of high-performance acoustic levitation systems for precision particle manipulation.

ICEMSET-2026/FS/INV/177

Variational Mode Decomposition-Assisted Edge AI Framework for State-of-Health Estimation of a Battery Pack

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Abstract

Reliable State-of-Health (SOH) estimation is essential for enhancing the safety, reliability, and operational lifespan of Lithium Iron Phosphate ($LiFePO_4$) battery systems. This work presents an edge intelligence framework for a custom-made 4S8P $LiFePO_4$ battery pack, integrating Variational Mode Decomposition (VMD) with deep learning to improve battery health diagnostics. VMD is employed to decompose voltage and current signals into intrinsic mode functions, effectively suppressing noise, isolating degradation characteristics, and extracting discriminative features for health assessment. The extracted features are processed by an edge-computing platform to achieve accurate and real-time SOH estimation under varying operating conditions. The proposed framework minimizes computational complexity while maintaining high prediction accuracy, making it suitable for electric vehicles, renewable energy storage systems, and intelligent battery management applications. Experimental results demonstrate that VMD-assisted feature extraction significantly enhances the robustness, stability, and accuracy of SOH prediction compared with conventional signal-processing and feature extraction techniques.

Keywords: State of Health (SoH); Remaining Useful Life (RUL); Machine Learning; Battery Monitoring System; Charging Cycle Optimization; Variational Mode Decomposition (VMD; Long Short-Term Memory (LSTM).

ICEMSET-2026/FS/INV/178

Organic materials for use as photosensitizers in therapeutics

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Abstract

Organic materials are potentially important for different applications including electronic components, displays, sensors and solar cells, wearables and recently in therapeutics. Among these metal Phthalocyanines and similar family of organic compounds are important as a photo sensitizer in photodynamic therapy applications. Deposition conditions of these organic compounds are of prime importance for medical applications. Post

deposition vacuum annealing techniques utilized in the preparation process of thin films to modify the absorption band in the visible region suitable for low cost therapy is a concern. Various processing techniques like doping or different preparation procedures are employed for the currently available materials used in cancer therapy. In this work, the annealing process employed for the modification of the absorption spectra is focussed. A brief review on the materials currently available for cancer therapy and the future scope of these organic materials including Phthalocyanines will be reported.

Keywords: Thin films; Optical absorption; Deposition; Annealing; Therapy.

ICEMSET-2026/FS/INV/179

Biofunctional Materials for Smart Biosensors and Healthcare Applications

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Abstract

Smart healthcare technologies are gaining more importance nowadays due to its development in the smart healthcare technologies. The mucin obtained from the Molluscan species such as Snail is a natural biomaterial best suited for its excellent biodegradability, biocompatibility and wound-healing properties. This experimental study focuses on the isolation and separation of snail mucin to investigate its anti-inflammatory and antioxidant properties. From the investigation, it suggests that snail mucin has the property to reduce inflammation and oxidative stress, making it a promising material for therapeutic and biomedical applications. The biological properties of snail mucin can be treated as a biofunctional material in AI enabled smart biosensors for supporting the sensitive detection of disease biomarkers. In integration with Internet of Things (IoT) devices, wearable sensors, and AI, mucin-based smart biosensors are used in personalized healthcare, real-time health monitoring and early diagnosis of diseases. This advanced approach helps to develop innovative, sustainable, and efficient healthcare solutions for future medical applications.

Keywords: Biofunctional material, Molluscan mucin, Antioxidant, Smart biosensors, Anti-inflammatory, Healthcare, Artificial Intelligence, IoT.

ICEMSET-2026/FS/INV/180

IoT-Enabled AI-Assisted BST–YBCO Superconducting Tunable Microwave Resonator for Adaptive RF Applications

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Abstract

This research work presents a complete simulation-based and measurement-oriented framework for the design of tunable microwave planar structures using ferroelectric and superconducting materials. In this experiment we studied many reconfigurable microwave components such as microstrip resonators, tunable bandpass filters, and phase-shifting planar structures and their development. For development we had used barium strontium titanate (BST) as a ferroelectric tunable dielectric and as a superconducting low-loss conductor we used yttrium barium copper oxide (YBCO). We have chosen Ferroelectric materials which provides electric-field-dependent permittivity variation. Use of superconducting materials reduces microwave loss and improve the Q-factor below their critical temperature. We had compared four configurations namely conventional copper microstrip resonator, BST-loaded microstrip resonator, YBCO superconducting resonator, and hybrid BST-YBCO tunable resonator. We had used material parameters, S-parameters, resonant frequency shift, insertion loss, return loss, bandwidth, Q-factor, tuneability, and temperature-dependent surface resistance as the main data outputs. For

analysis combination of simulations tools CST Microwave Studio, ANSYS HFSS, and COMSOL Multiphysics are used. Outcome and results are validated using Vector Network Analyzer measurements and cryogenic testing. Analysis of results shows that BST loading improves tuneability, with YBCO structures improving Q-factor and hybrid BST-YBCO structure providing balanced performance. This work demonstrates that hybrid ferroelectric-superconducting microwave planar structures can support next-generation adaptive communication in strategic fields.

Keywords: BST, YBCO, superconducting resonator, IoT, microwave resonator, tuneable filter, adaptive RF systems, HFSS.

ICEMSET-2026/FS/INV/182

Digital Twin framework for superconducting systems

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Abstract

The Superconducting devices are the systems that utilise the unique properties of superconductors. Since their discovery superconducting devices have played a crucial role in various fields of physics, precision measurement, quantum technologies, medical imaging, and fundamental physics. Their functioning is mainly dependent on the macroscopic quantum phenomena, making them fundamentally different from the conventional semiconductor-based devices. The accurate measurement and the optimization of superconducting devices are essential as their operation and functioning is governed by highly sensitive quantum and nonlinear phenomena. The precise cryogenic measurements are necessary to correctly characterize the key parameters to ensure that the superconducting device operates within the desired quantum regime for the optimal performance. In electrical metrology, the quantum superconducting devices such as Josephson voltage standards provide a direct realization of SI units through fundamental constants. Any changes in the bias conditions and any degradation in device parameters affect the voltage quantization accuracy and long-term stability Now a days, Artificial Intelligence (AI) has become increasingly important for superconducting devices because these systems illustrate highly nonlinear, noise-sensitive, and multi-parameter aspects that are difficult to model, analyse and control using conventional methods alone. Recent studies have shown that AI and Digital Twin (DT) technologies together can provide a promising approach toward addressing the challenges faced during the measurement of the superconducting devices. When combined with AI, DTs can enable intelligent diagnostics, predictive maintenance, adaptive control, and uncertainty-aware decision-making. Machine learning models can detect early signs of parameter degradation or device failure, predict future behaviour, and support digital twin frameworks for predictive maintenance.

Keywords: Digital Twin, AI, Machine learning, Cryogenic, Quantum technologies.

ICEMSET-2026/FS/INV/183

Deep Freeze Magnetism: Unraveling Cryogenic Physics of Double Perovskites

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Abstract

To explore complex magnetic phenomenon oxide double perovskites ($A_2MM'O_6$) are an exceptionally rich playground where M-site cation ordering, spin orbital coupling along with competing exchange interactions results in exotic magnetic and electronic ground states. Many of these subtle interactions persists obfuscated by thermal fluctuations at room temperature, but diverse novel magnetic behaviors such as field induced meta magnetic transitions, Griffiths like phase, spin glass behavior and spin frustrations can be observed when cooled to cryogenic regimes. In present talk, we discuss a comprehensive low- temperature magnetic study of selected

La_2CoMnO_6, where initially Cobalt was substituted with Iron to understand the effect of M-site substitution and later Lanthanum was substituted with Praseodymium to see the effect of A- site substitution. The effect of structural distortions and M-site antisite disorder disturbing long-range magnetic order and inducing cluster like states and glassy dynamics, has been systematically elucidated.

Keywords: Double perovskites, metamagnetic transitions, spin glass behaviour.

ICEMSET-2026/FS/INV/184

Origin and Evolution of Complex Magnetic Phases in Rare-earth Double Perovskites $R_2TT'O_6$

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Abstract

Rare earth-based double perovskites ($R_2TT'O_6$) represent an interesting class of multifunctional magnetic oxides due to high coupling between the crystal lattice, electronic state and magnetic exchange interactions. Magnetic oxides demonstrate various novel magnetic properties such as magnetic compensation, negative magnetization, exchange bias, Griffiths behavior, cluster glass states, and magnetocaloric effect. Usually, the appearance of such magnetic states can be associated with competing exchange interactions, ordering of B-site cations, antisite defects, oxygen vacancies, and the contribution of magnetic rare earth ions. Nevertheless, physical principles behind these correlated magnetic states remain poorly understood. This seminar is devoted to consideration of existing models of magnetic interactions in rare earth double perovskites and recent achievements in the description of magnetic phase evolution in these materials. Emphasis will be placed on crystal chemistry, magnetic compensation, cation disorder, and oxygen defects effects on the appearance of exchange bias and Griffiths-type magnetic properties. Also, a research strategy for comprehensive studies of selected $R_2TT'O_6$ systems in terms of structure–property relationship will be provided. The purpose of this research is to establish a connection between theory and experiment and to gain a better understanding of the phase diagrams of rare-earth double perovskites. The results will be useful for the development of magnetic materials suitable for spintronics, magnetorelaxometry, and magnetic refrigeration.

Keywords: Double perovskites; Rare-earth oxides; Magnetic interactions; Exchange bias; Griffiths phase; Spintronics.

ICEMSET-2026/FS/INV/185

Design and Development of Cost-Effective Anode Materials for Future Potassium-Ion Battery Applications

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Abstract

The growing demand for sustainable energy storage has accelerated the search for alternatives to lithium-ion batteries owing to the limited and uneven global distribution of lithium resources. Among emerging technologies, potassium-ion batteries (PIBs) have attracted significant attention because of the natural abundance and low cost of potassium, fast ion transport kinetics, and competitive energy densities. However, the practical application of PIBs is hindered by the limited reversible capacity, poor rate capability, and inadequate cycling stability of the current anode materials. Alloy-type anodes offer high theoretical gravimetric and volumetric capacities but suffer from severe volume expansion during potassiation/depotassiation, leading to rapid capacity fading. This study presents effective strategies to overcome these challenges by engineering nanosized alloy-based anodes through a simple chemical synthesis route, followed by uniform amorphous carbon coating to enhance electrical conductivity, suppress nanoparticle agglomeration, and buffer volume changes. Furthermore, the design of binary alloy composites provides mutual structural support between the electrochemically active metals, effectively mitigating mechanical degradation and improving long-term cycling

stability. These rational design strategies provide a promising pathway for the development of high-performance, cost-effective alloy-based anode materials for next-generation potassium-ion batteries.

ICEMSET-2026/FS/INV/186

Advanced Materials Characterization and Performance Evaluation of Sustainable Bio-Fiber Reinforced Cementitious Composites

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Abstract

Sustainable bio-fiber-reinforced cement composites are promising for durable, eco-friendly infrastructure. This study conducts an extensive experimental investigation of flax- and hemp-fiber-reinforced engineered cementitious composites, utilizing advanced material characterization and mechanical testing. Techniques such as Field Emission Scanning Electron Microscopy (FESEM), X-ray Diffraction (XRD), Energy Dispersive Spectroscopy (EDS), and 3D Scanning Probe Microscopy (3D-SPM) were used to examine fiber morphology, surface features, hydration products, elemental composition, and fiber–matrix bonding. Mechanical tests, including split tensile and interfacial bond assessments, showed that alkali-treated flax fibers led to improved fiber–matrix adhesion, denser hydration products, better crack-bridging, and stronger bonds. A life cycle assessment highlighted the environmental advantages of natural fiber composites, emphasizing their potential as sustainable, high-performance building materials.

Keywords: Bio-fiber Reinforced Cementitious Composites; Advanced Materials Characterization; FESEM & XRD; Interfacial Bond Performance; Sustainability analysis.

ICEMSET-2026/FS/INV/187

Nanomaterials in Antibacterial Applications

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Abstract

Antibiotics are among the basic drugs prescribed by doctors and are the most important area of historical research. Antibiotics have allowed for successful treatments of life-threatening diseases, but the overuse of antibiotics over the past few decades has led to a growing public health concern: antibiotic resistance. Antibiotic resistance happens when bacteria survive the effects of drugs that would normally kill them or inhibit their growth. This results in the emergence of bacteria that are resistant to multiple classes of antibiotics, making once-treatable infections difficult or even impossible to treat. Nanoparticles (NPs) have emerged as promising candidates in the fight against antibiotic resistance. They have profound potential and are highly effective for treating resistant microbes due to their minuscule size; they offer a much larger surface area in proportion to their overall volume. In addition to their direct antimicrobial activity, NPs exhibit synergistic effects when combined with conventional antibiotics, enhancing the potency of existing treatments.

Keywords: Antibiotics; Self-medication; Resistance; Bacteria; Nanoparticles.

ICEMSET-2026/FS/INV/188

Interface-Driven Charge Storage Enhancement in Cerium Oxide/Hydroxide–Nickel Hydroxide Composites

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Abstract

Interface-driven charge storage in nickel hydroxide-based electrodes offers an effective strategy for improving ion transport and electrochemical performance. In this study, electroactive cerium oxide/hydroxide was integrated with α-$Ni(OH)_2$ through a facile coprecipitation method to engineer abundant interfacial active sites and enhance surface properties. The resulting nanoarchitecture, featuring cerium oxide/hydroxide spheres decorated on $Ni(OH)_2$ nanosheets, establishes synergistic interfaces that facilitate rapid ion diffusion and electron transport during charge–discharge processes. The role of the engineered interface in governing electrochemical kinetics and the contributions of diffusion-controlled and surface-controlled charge-storage mechanisms were systematically evaluated. A symmetric supercapacitor device fabricated using the optimized composite delivered a specific energy of 54 W h kg^{-1} at a specific power of 1.28 kW kg^{-1}. The enhanced charge-storage performance highlights the significance of interface engineering and demonstrates the potential of the cerium oxide/hydroxide–nickel hydroxide composite as an advanced electrode material for battery-type supercapacitors.

Keywords: Cerium oxide/hydroxide, coprecipitation method, upgraded electrochemical activity, battery-type supercapacitor.

ICEMSET-2026/FS/INV/189

Plasmon-Enhanced TiO_2 Thin Films for High-Performance UV Photodetectors

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Abstract

This study explores the effect of Silver (Ag) nanoparticles (NP) embdded on Titanium Dioxide (TiO_2) thin films in a multi-layer form of Ag-NP/TiO_2-TF/Ag-NP/TiO_2-TF fabricated on p-type Silicon using the E-beam vacuum evaporation technique. Field Emission Scanning Electron Microscopy (FESEM) confirms the successful deposition of Ag nanoparticles and TiO_2 thin film. X-ray diffraction (XRD) plots show the presence of anatase TiO_2 and Ag NP. Optical absorption spectra show a 1.5-fold enhancement in absorption in the UV region for the samples that contain Ag-NPs as compared to bare TiO_2-TF samples. Bandgap of Ag-NP/TiO_2-TF/Ag-NP/TiO_2-TF and TiO_2-TF samples were calculated to be ~3.2 eV and ~3.4 eV, respectively. The *I-V* characteristics show detection of both UV light and visible blue light, but the performance is better under UV illumination due to plasmonic effect of Ag NPs.. Moreover, response time analysis of Ag-NP/TiO_2-TF/Ag- NP/TiO_2-TF device shows a fast rise time of ~252 ms and a fall time of ~327 ms. Thus, the fabricated device has shown good potential for use as a low-cost and fast-response UV photodetector.

Keywords: E-beam deposition, Nanoparticle, Thin film, TiO_2, Photodetector.

ICEMSET-2026/FS/INV/190

Functional Nanomaterials for Hydrogen Gas Sensing Applications

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Abstract

The Hydrogen (H_2) economy provides enormous possibilities for strengthening clean energy security and mitigating greenhouse gas emissions worldwide. Hydrogen leakage such as fire hazard when exceeds 4% in air, and highly flammable, make it of utmost importance to develop highly sensitive, fast and reliable and economical hydrogen sensors. Functional nanomaterials; Pd-decorated magnesium (Mg) thin films/multilayers, and MgPd alloy-based thin films, acquire significant advances in recent times to detect hydrogen gas. MgPd alloy thin film-based sensor exhibits high response at room temperature for wide range of hydrogen concentration with fast response time. In addition to this, Pd-capped nanostructured metal oxides semiconductors (NMOS) have become interesting architecture to design chemiresistive gas sensors for the

detection of small quantity of hydrogen gas. The sensing performance of NMOS thin film-based gas sensors are found to be remarkable for low ppm concentration of hydrogen gas at moderate operating temperature. Pd-decorated NMOS-based sensor also presents strong stability for a longer duration even in humid conditions. The sensors are found highly selective towards hydrogen gas in comparison to other gases such as nitrogen, dioxide, carbon monoxide and ammonia.

Keywords: Hydrogen energy; thin film; Sensor; Magnesium; Palladium; Metal oxides; Selectivity.

ICEMSET-2026/FS/INV/191

Electrochemical Performance of Phytosynthesized Copper Sulfide Nanoparticles

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Abstract

Copper sulfide is well known material having applicability in different areas due to its non-toxicity and cost-effectiveness. In the present work, copper sulfide and doped copper sulfide nanoparticles are synthesized by an "integrated hydrothermal-green approach," for investigating their electrochemical properties. Copper sulfide nanoparticles are synthesized by facile hydrothermal technique using Urtica Diocia leaves extract along-with copper and sulfur precursors. The formed copper sulfide nanoparticles are characterized by different techniques to identify crystal structure, elemental composition, morphology and size-distribution. The electrochemical performance of copper sulfide nanoparticles with KOH electroyte is monitored by transferring nanoparticles onto graphite sheet. Many redox peaks are seen in cyclic voltametry curves revealing conversion of copper sulfide into different phases. With the increase in the molarity of KOH electroyte from 1M to 2M increase in the specific capacitance from 95 to 175 F/g is observed with the scan rate of 5 mV/s.

Keywords: copper sulfide, nanoparticles, phytosynthesis and electrochemical performance.

ICEMSET-2026/FS/INV/192

Microwave-Hydrothermal Synthesis and Properties of Co_3O_4 nanoparticles

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Abstract

Cobalt oxide (Co3O4) nanoparticles were generated by microwave-assisted hydrothermal technique and studied by structural, optical, surface, and electrochemical properties. High crystallinity single-phase spinel structure indexed to the face-centered cubic Co3O4 phase is confirmed by XRD investigation. FTIR research reveals spinel Co_3O_4 production via unique vibrational bands. Peaks at 571 cm^{-1} and 666 cm^{-1} indicate Co–O bonds at octahedral and tetrahedral locations, indicative of the spinel structure. XPS revealed the coexistence of Co^{2+} and Co^{3+} oxidation states and confirmed the purity of the produced material. The optical behavior was examined using UV-Vis absorption spectroscopy. The material's pseudocapacitive nature was further confirmed by galvanostatic charge-discharge (GCD) analysis, which yielded specific capacitance values of 1284, 961, 822, 674, and 577 F/g at scan rates of 5, 10, 15, 20, and 25 mV s-1, respectively. In addition, the charge transfer and ion diffusion properties of Co_tO_4 electrodes were studied using EIS. At low frequencies, Warburg impedance was shown by a linear tail, but at high frequencies, a semicircular arc indicated charge transfer resistance (Rct). The low Rct value in Co_3O_4 indicates efficient electron transfer and strong electrochemical properties finds useful applications in batteries.

Keywords: Co_3O_4, Nanomaterials, XPS, UV-Vis spectroscopy, Electrochemical properties.

ICEMSET-2026/FS/INV/193

Meglumine-immobilized CuI NPs Promoted Synthesis of Therapeutically Important Spiro[indoline-pyrazolo[5,1-*b*]quinazoline] tethered 1,2,3-Triazoles

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Abstract

Recent developments in green and sustainable practices across various scientific disciplines employ heterogeneous catalysts as essential tool. Reports of various organic transformations driven by heterogeneous catalysts are increased in current years. Straightforward separation, convenient recycling and ease of handling are some of the key features of these catalysts. However, many challenges are associated with their preparation. Thus, application of unmodified solid supports for immobilization is vital. In the same line, we are currently working on utilization of meglumine-based catalysts for designing sustainable protocols to construct biologically privileged heterocyclic scaffolds. Moreover, synthesis of 1,2,3-triazoles received much attention in recent time due to their varied applications in diverse fields. In this perspective, we prepared heterogeneous catalyst 'meglumine-immobilized CuI NPs' and characterized it using XRD, FE-SEM, EDX TEM, XPS, TGA, IR and ^{1}H NMR. The developed heterogenous catalyst was employed for synthesis of diversely substituted spiro[indoline-pyrazolo[5,1-b]quinazoline] tethered 1,2,3-triazole derivatives. Silent features of the developed protocol are mild reaction conditions, easy purification, moderate to good yield. The heterocyclic motifs were well characterized using ^{1}H NMR, ^{13}C NMR, and mass spectrometry. Furthermore, synthesized 1,2,3-triazole motifs were subjected for antiproliferative potential assessment against six humans solid tumor cell lines. Some of the tested molecules have shown high potency against the A549 (lung) cell line.

Keywords: Click approach, Meglumine supported CuI NPs, Biologically important 1,2,3-triazoles, Green protocol, Heterogeneous catalyst.

ICEMSET-2026/FS/INV/194

IoT-Based Home Energy Management Systems for Intelligent and Sustainable Smart Homes

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Abstract

The increasing demand for energy efficiency and renewable energy integration has emphasized the need for intelligent Home Energy Management Systems (HEMS). This invited talk presents research on the design and development of an IoT-based HEMS for real-time monitoring, intelligent load management, and demand response in residential environments. The proposed system integrates smart sensing, wireless communication, and coordinated energy management strategies to optimize electricity consumption while maintaining user comfort. Experimental validation demonstrates improvements in energy utilization, electricity cost reduction, and demand-side management. The presentation will discuss the developed hardware prototype, system architecture, implementation methodology, and key research findings. In addition, the practical role of IoT-enabled HEMS in supporting smart grids and sustainable smart homes will be highlighted. The talk concludes with future research directions involving Artificial Intelligence (AI), predictive energy management, and autonomous decision-making for next-generation residential energy systems.

Keywords: Home Energy Management System (HEMS); Internet of Things (IoT); Demand Response; Smart Grid; Artificial Intelligence.

ICEMSET-2026/FS/INV/195

Engineering Two-Dimensional Materials and Nanocomposites for Advanced Field Emission, Photocatalysis, and High-Performance Supercapacitors

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Abstract

Two-dimensional (2D) materials and their nanocomposites are revolutionizing advanced functional materials research by offering unprecedented opportunities for high-performance energy conversion, energy storage, and environmental remediation. Their atomically thin structure, tunable electronic properties, abundant active sites, and exceptional charge transport enable superior performance compared with conventional nanomaterials. Recent advances in interface engineering, defect modulation, and heterostructure design have significantly enhanced field emission characteristics by reducing turn-on electric fields and improving emission stability. Simultaneously, synergistic nanocomposite architectures facilitate efficient charge separation, leading to remarkable photocatalytic activity for solar-driven pollutant degradation and hydrogen evolution. In electrochemical energy storage, rationally engineered 2D heterostructures exhibit outstanding specific capacitance, rapid ion diffusion kinetics, and long-term cycling durability, making them ideal electrode materials for next-generation supercapacitors. Future research should focus on scalable green synthesis, precise interface engineering, AI-assisted materials discovery, operando characterization, and multifunctional device integration to accelerate the translation of 2D nanocomposites from laboratory-scale demonstrations to commercially viable sustainable energy technologies.

Keywords: Two-Dimensional (2D) Materials, Nanocomposites, Field Emission, Photocatalysis, Supercapacitors.

ICEMSET-2026/FS/INV/196

An AI-Enabled Smart MEMS Sensor Framework for Sustainable Forest Monitoring and Climate Resilience

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Abstract

Climate change and increasing environmental disturbances necessitate intelligent and real-time forest monitoring systems for sustainable resource management. This paper proposes a Smart MEMS-Based Environmental Monitoring Framework that integrates Micro-Electro-Mechanical Systems (MEMS) sensors, Internet of Things (IoT), Artificial Intelligence (AI), and Geographic Information Systems (GIS) to support climate-resilient forest management. The conceptual framework employs MEMS-based sensors to continuously monitor key environmental parameters, including temperature, humidity, soil moisture, atmospheric gases, and air quality. The collected data are transmitted through IoT networks and integrated with multi-source remote sensing observations to provide comprehensive spatiotemporal assessment of forest conditions. AI algorithms analyze the fused datasets to predict wildfire risk, detect ecosystem anomalies, and assess forest health, while Explainable AI enhances the transparency and reliability of model predictions. The proposed framework provides a scalable and energy-efficient approach for intelligent forest monitoring, enabling timely decision-making for biodiversity conservation, climate adaptation, disaster preparedness, and sustainable forest resource management.

Keywords: MEMS Sensor, Sustainable Forest Monitoring, IoT, AI, GIS.

ICEMSET-2026/FS/INV/197

RSM Optimization of Microwave Pyrolysis Conditions to Develop a Highly Porous Orange Peel derived char for Energy Storage Applications

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Abstract

This study is focussed upon the conversion of orange peel into orange peel char (OPC) through microwave pyrolysis technique to fabricate a supercapacitor electrode for energy storage applications. Orange peel was pyrolyzed under and the effect of microwave p[ower, radiation time and particle size was observed on the OPC yield and its BET surface area. OPC yiled was lowered with rise in any of the investigated process parameters. However, BET surface area of OPC initially increased and further increase in any of the process parameter reduced the BET surface area. Further RSM based optimization was usd for the optimization the pyrolysis conditions to achieve maximum yield and BET surface area of OPC. OPC synthesized under optimized conditions was characterized using ultimate-proximate analysis, Thermophysical analysis, TGA, FT-IR, XRD and SEM for thermal stability and structural, compositional and morphological properties. OPC derived electrode was then developed and its EIS, GCD and cyclic volatmetry analysis was conducted.

Keywords: Biochar; Energy storage; Microwave pyrolysis; Orange peel; RSM optimization; Supercapacitor electrode.

ICEMSET-2026/FS/INV/199

Non-Invasive Non-Enzymatic Electrochemical Biosensors based on MXene/Polymer based Nanocomposites

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Abstract

The development of non-invasive electrochemical biosensors has gained considerable attention in personalized healthcare and point-of-care diagnostics, particularly in wearable electronics for glucose monitoring, due to their significant advantages such as continuous real-time monitoring, enhanced performance, cost-effectiveness, ease of operation, rapid detection, and miniaturization. However, limited sensitivity, stability, and enzyme degradation remain limitations of the biosensors. To address these issues, this study emphasises the development of non-invasive, non-enzymatic electrochemical glucose monitoring using human sweat. The proposed approach employs MXene/Polymer nanocomposites as the active sensing material. The developed modified SPCE modified MXenes/Polymer nanocomposites will be used to evaluate glucose detection via cyclic voltammetry. The biosensing characteristics of sensitivity, selectivity, reproducibility, repeatability, and long-term stability will be evaluated using a differential pulse voltammetry technique. The practical applicability of the sensor will be validated using artificial sweat and emerge as a promising platform for low-cost, wearable bio-electronic devices.

Keywords: Biosensors; Glucose monitoring; Wearable Electronics; MXenes, Polymers, Sweat.

ICEMSET-2026/FS/INV/200

AI-Driven Intelligent Transaction Optimization for Industry 5.0 Digital Financial Infrastructure

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Abstract

The rapid evolution of artificial intelligence (AI) and decentralized digital technologies is redefining the architecture of future digital financial infrastructure by enabling intelligent, secure, and adaptive transaction management. However, dynamic network congestion and fluctuating transaction fees in blockchain systems often lead to increased confirmation delays, inefficient resource utilization, and higher transaction costs. Addressing these challenges requires intelligent optimization techniques capable of learning from historical transaction patterns while adapting to real-time network conditions. This paper presents an AI-driven intelligent transaction optimization framework that combines multi-feature machine learning with Retrieval-Augmented Generation (RAG) to predict optimal transaction fees and improve transaction confirmation efficiency. The proposed framework analyzes diverse blockchain and mempool characteristics, including transaction size, fee rate, network congestion, mempool occupancy, confirmation history, and temporal transaction patterns, to develop a robust predictive model. The RAG module enhances the prediction process by retrieving contextually relevant historical transaction information, enabling adaptive and knowledge-assisted decision-making under varying network conditions. Experimental evaluation demonstrates that the proposed approach achieves higher prediction accuracy, lower confirmation latency, and improved computational efficiency compared with conventional fee estimation techniques. The framework effectively balances transaction cost and confirmation speed while dynamically responding to changes in blockchain network behavior. The proposed solution contributes to the development of intelligent digital financial infrastructure by integrating predictive analytics, context-aware retrieval, and adaptive optimization into decentralized transaction processing. Beyond Bitcoin, the framework provides a scalable AI-enabled approach applicable to emerging digital payment ecosystems and next-generation decentralized financial platforms, supporting the advancement of secure, resilient, and intelligent financial services aligned with future digital technologies.

Keywords: Artificial Intelligence, Machine Learning, Retrieval-Augmented Generation, Blockchain, Bitcoin, Transaction Fee Prediction, Digital Financial Infrastructure, Intelligent Transaction Optimization.

ICEMSET-2026/FS/INV/201

Organic Thin-Film Transistors: The Road Ahead

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Abstract

Organic Thin-Film Transistors (OTFTs) are emerging as promising devices for their potential applications in the field of healthcare, sensors and marketing applications etc. OTFTs have already dominated the display market where they are used in large matrix display backplanes and research is focused on improving their performance for use as driver elements in large matrix displays. The OTFTs also find applications in MEMS where they are used to fabricate artificial skin and bio-nose. The applications of OTFTs are varied as they can be fabricated on low-cost flexible substrates unlike the inorganic counterpart. Towards the end of 2030 and ahead, it has been estimated that the organic market will be a $250 billion business without replacing much from the inorganic semiconductors in existing electronic products. Organic TFT's offer "cradle-to-cradle" Electronics becoming the most popular choice in the era of sustainability. In recent years, the goal of OTFTs has shifted from merely trying to "copy silicon" to establishing entirely new paradigms where organic materials outperform traditional electronics. The current landscape offers OTFTs moving into neuromorphic computing, biocompatible interfaces, and circular electronics. OTFTs have shifted from lab to fab and are commercially available for varied applications. Research has been conducted on the performance improvement of these devices through material and device engineering. In this presentation, a detailed discussion shall be carried on the performance improvement of OTFTs. The cutting-edge applications of OTFTs along with the sustainable electronics offered shall be discussed.

ICEMSET-2026/FS/INV/203

Neuromorphic Hardware and Software: The present and future prospective for Spintronics

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Abstract

Biological brains are not just hardware running sort of software or computations but this hardware is the actual software. The increasing need for real-time artificial intelligence in edge platforms and the issues pertaining to scaling limitations of conventional non-volatile memory (NVM) devices demands neuromorphic hardware that is both ultrafast and energy-efficient. Neuromorphic engineers and researchers need to be creative as well as cautious in taking inspiration from biological intelligence and mapping it to real hardware. This opinion article highlights major role of neuroscience in implementing real-time neuromorphic computing hardware system and is prepared for journal's Neuron's NeuroViews section. Researchers need to identify the physics and principles of biological intelligence and then further map to actual next-generation physical hardware.

ICEMSET-2026/FS/INV/204

Advanced Transistors: A Step Towards 3 nm and 2 nm Nodes in Semiconductor Technology

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Abstract

The semiconductor industry is rapidly advancing from 5 nm to 3 nm and 2 nm technology nodes, driven by the growing demands of artificial intelligence (AI), high-performance computing (HPC), 5G/6G communications, and edge computing. Conventional planar MOSFETs and FinFETs are approaching their physical scaling limits due to short-channel effects, leakage current, power density, process variability, and quantum mechanical challenges. This presentation highlights the transition toward next-generation transistor architectures, including Gate-All-Around (GAA) nanosheet transistors and Complementary FET (CFET) technologies for sub-2 nm applications. It discusses key device engineering challenges such as enhanced electrostatic control, power-performance optimization, reduced leakage, and fabrication complexity. This paper also explores enabling technologies, including extreme ultraviolet (EUV) lithography, backside power delivery, advanced channel materials, and 3D integration. Furthermore, it examines recent innovations from leading semiconductor industries and research organizations, illustrating how these technologies sustain Moore's Law while improving energy efficiency, scalability, and computing performance for future electronic systems.

Keywords: Gate-All-Around (GAA) Transistors; Complementary FET (CFET); Advanced Semiconductor Technology; EUV Lithography; Sub-2 nm Technology Nodes.

ICEMSET-2026/FS/INV/205

Designing, synthesis and characterization of novel monocarbonyl curcuminoids as antibacterial and antituberculosis agents

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Abstract

In order to improve the physiological stability and the antibacterial activity of curcuminoids against drug-resistant bacteria, a series of novel monocarbonyl curcuminoids were synthesized and screened for antibacterial activity against *S. aureus* and *E. coli* strains. These curcuminoids showed potent antibacterial activity against both methicillin-sensitive and methicillin-resistant strains of *S. aureus* with MIC values 2-8 and 4-16 μg/mL, respectively. Mechanistic studies revealed that these curcuminoids displayed potent bactericidal activity by

targeting cell membranes. Further these compounds were also found to be possessing potent antituberculosis activity with MIC_{99} in the range of 3.12–25.0 µM, out of which two compounds were found the most potent, with MIC_{99} in the range of 3.12–6.25 µM. Furthermore, these compounds were observed to be nonhaemolytic, nontoxic, and stable under both physiological as well as reducing conditions.

Keywords: Curcumin; Curcuminoids; *S. aureus*; Antibacterial; *Mycobacterium tuberculosis*.

ICEMSET-2026/FS/INV/206

Rare Earth–Transition Metal Co-Doping Strategy for High-Performance Co_3O_4 Supercapacitor Electrodes

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Abstract

Cobalt oxide (Co_3O_4) is a promising pseudocapacitive electrode material; however, its practical performance is limited by poor electrical conductivity and sluggish ion transport. In this study, pristine and Gd–Cu co-doped Co_3O_4 nanostructures were synthesized via a simple co-precipitation method to improve their electrochemical properties. X-ray diffraction confirmed the formation of a cubic spinel structure (space group $Fd\bar{3}m$), while co-doping reduced the crystallite size from 33 to 14 nm due to lattice strain. FTIR, Raman, FESEM, and XPS analyses verified the spinel phase, porous morphology, mixed Co^{2+}/Co^{3+} oxidation states, successful incorporation of Gd^{3+} and Cu^{2+}, and enhanced oxygen-vacancy concentration. Electrochemical measurements in 6 M KOH demonstrated superior capacitive performance for the $Co_{2.7}Gd_{0.1}Cu_{0.2}O_4$ electrode, which delivered a specific capacitance of 711 F g^{-1} at 10 mV s^{-1}, compared with 516 F g^{-1} for pristine Co_3O_4. It also achieved a maximum energy density of 11.76 Wh kg^{-1} at a power density of 1100 W kg^{-1}. The enhanced performance is attributed to the synergistic effects of Gd–Cu co-doping, lattice distortion, oxygen vacancies, and the porous nanostructure, making $Co_{2.7}Gd_{0.1}Cu_{0.2}O_4$ a promising electrode material for high-performance supercapacitors.

Keywords: Co-precipitation synthesis; Supercapacitor; Specific capacitance; Electrochemical energy storage.

ICEMSET-2026/FS/INV/208

Flexible Organic Memristive Devices with Conducting Polymer Active Layers

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Abstract

The resistive switching memory has been investigated in conducting polymer poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS). Current-voltage (I-V) characteristics of the fabricated Al/PEDOT:PSS/ITO/ flexible PET substrate device reveal a non-volatile resistive switching behaviour. The memory device demonstrates transparency and flexibility with ON/OFF current ratio between the high resistance state (HRS) and low resistance state (LRS) of ~10^4 in magnitudes at a reading voltage of 1V. The charge transport mechanism of the fabricated non-volatile organic devices is governed by the space-charge limited conduction (SCLC). It has been suggested that the switching mechanism is due to the reduction and oxidation of PEDOT: PSS film. Interestingly, the performance of the memory device revealed no detectable degradation and remained identical even after bending the device from 70-160^0 angles, representing excellent flexibility. This Al/PEDOT:PSS/ITO/ flexible PET substrate-based ReRAM (resistive random access memory) device exhibited high potential for future flexible non-volatile memory device applications.

Keywords: Conducting Polymer PEDOT:PSS, Flexible Nonvolatile Resistive switching Memory, Excellent Flexibility Memory Device.

ICEMSET-2026/FS/INV/209

Comparative Time- and Frequency-Domain Analysis of Electric and Diesel Bus Acoustic Signals Using Digital Signal Processing Techniques

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Abstract

The growing adoption of electric buses has increased the need to analyse their acoustic characteristics in comparison with conventional diesel buses for applications in traffic monitoring, environmental noise assessment, and intelligent transportation systems. This study presents a comparative analysis of electric and diesel bus audio signals using digital signal processing and statistical techniques implemented in R. The audio recordings were normalized and analysed in both the time and frequency domains. Statistical measures, waveform characteristics, autocorrelation, amplitude envelope, root mean square (RMS), zero crossing rate (ZCR), Fast Fourier Transform (FFT), Power Spectral Density (PSD), spectrograms, fundamental frequency, and Mel Frequency Cepstral Coefficients (MFCCs) were extracted and compared. Welch's two-sample t-test on frame-wise RMS values revealed a significant difference between the two vehicle types ($p < 0.001$). The results demonstrate distinct temporal and spectral characteristics of electric and diesel bus sounds, providing a reliable framework for acoustic characterization, vehicle identification, and future machine learning-based classification.

Keywords: Acoustic signal analysis; Spectrogram; Mel Frequency Cepstral Coefficients; Zero Crossing Rate; Welch's t-test.

ICEMSET-2026/FS/INV/210

Molecular Design of Carbazole–Cyanostilbene Materials for Modulating Solid-State Luminescence

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Abstract

The development of organic luminogenic materials with predictable and controllable solid-state optical responses is of significant interest for advancing functional materials. In this presentation, we describe a molecular engineering approach to carbazole-based donor–acceptor systems aimed at understanding and controlling their photophysical behavior in the aggregated and solid states. A series of structurally diverse luminogens was developed by manipulating the π-conjugated spacer, donor–acceptor configuration, molecular symmetry, donor substitution pattern, and nature of the electron-accepting unit. Such structural modifications enabled systematic control over the electronic communication between the donor and acceptor components and, consequently, the emission characteristics of the resulting materials. Particular emphasis is placed on elucidating the interplay between molecular structure, excited-state interactions, and solid-state molecular organization in determining aggregation-induced emission, solid-state fluorescence, and reversible mechanofluorochromism. The resulting luminogens exhibit widely tunable emission spanning the visible to near-infrared region, together with enhanced solid-state luminescence and distinct stimuli-responsive color changes. The observed optical responses are correlated with variations in charge-transfer character, intramolecular electronic coupling, conformational dynamics, and intermolecular packing. Overall, this work establishes useful structure–property correlations for carbazole-based donor–acceptor luminogens and demonstrates how molecular-level design can be employed to engineer responsive solid-state emitters. These materials offer promising opportunities for applications in organic optoelectronics, chemical sensing, information security, and stimuli-responsive photonic systems.

ICEMSET-2026/FS/INV/211

Existence of Phase Separation in (1-x)Ba(A,Nb)O_3-(y)$PbTiO_3$ Based Perovskite Ceramics

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Abstract

The search for alternatives to toxic $PbTiO_3$-based piezoceramics has intensified over the past two decades due to their widespread use in piezoelectric, dielectric, and ferroelectric applications. Their superior properties are primarily associated with the morphotropic phase boundary (MPB) and nanoscale polar regions, which promote efficient polar-domain alignment under an applied electric field. In this direction, we have studied a series of solid solutions, $(1-x)Ba(A,Nb)O_3–yPbTiO_3$ [A = Cu, Zn, Mg, and Sc] for nearby MPB compostions, involving partial replacement of Pb and significant compositional variation at the B-site to introduce sub-micron-scale chemical inhomogeneity. Rietveld refinement of the XRD was used to investigate the crystal structures at MPB compositions and understand the origin of enhanced piezoelectric properties. Interestingly, all studied compositions are observed to show an unusual phase-separation behavior, characterized by the coexistence of a monoclinic or tetragonal secondary phase with a major tetragonal phase fraction. The observation of such phase-separation behavior provides important insights into the role of structural complexity and chemical inhomogeneity in governing the functional properties of these materials. A detailed understanding of this behavior may therefore provide a useful pathway for establishing structure–property correlations and for designing lead-reduced or lead-free piezoelectric materials with enhanced electromechanical performance.

Keywords: Phase coesistance, Phase Separation, Rietveld Refinement, Synchrotron XRD, $PbTiO_3$ based ceramics.

ICEMSET-2026/FS/INV/212

Superparamagnetic Iron Oxide Nanoparticle-Based Thermosensitive Hydrogel for Magnetic Hyperthermia-Assisted Targeted Therapy in Epithelial Ovarian Cancer

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Abstract

Nearly 22,000 death in India with 75% advanced FIGO stage of III-IV observed for Epithelial ovarian cancer (EOC) required targeted therapeutics application because of conventional limitations of cytoreductive surgery and hyperthermic intraperitoneal chemotherapy (HIPEC), leads to high relapse rates. This ICMR project is developing a superparamagnetic iron oxide nanoparticle (SPION)-embedded thermosensitive hydrogel enabling magnetically-triggered hyperthermia with sustained, localized chemotherapy as a minimally invasive HIPEC alternative. Foundational work established a reproducible SPION synthesis and functionalization pipeline (12–61 nm particles; confirmed crystallinity, morphology and magnetic saturation via XRD/TEM/VSM), 48.82% drug-loading efficiency, up to 86% carcinoma-cell inhibition *in vitro*, and superior tumour regression without organ toxicity in preclinical models using a validated alternating-magnetic-field platform, culminating in an approved Indian patent. Leveraging multi-institutional expertise across KolGOTRG, Santosh University and Mag-Heals, this platform will now be optimized into a drug-eluting hydrogel and preclinically validated for targeted, hyperthermia-assisted ovarian cancer therapy.

Keywords: Superparamagnetic iron oxide nanoparticles (SPIONs); Thermosensitive hydrogel; Magnetic hyperthermia; Hyperthermic intraperitoneal chemotherapy (HIPEC); Epithelial ovarian cancer.

ICEMSET-2026/FS/INV/213

EXO-RA SmartHand®: An AI-Driven Multimodal Sensing and Soft Robotic Platform for Personalized Hand Rehabilitation in Rheumatoid Arthritis

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Abstract

Rheumatoid arthritis frequently compromises hand function, requiring rehabilitation strategies capable of objectively monitoring biomechanical performance and adapting therapeutic support to individual needs. EXO-RA SmartHand® is an intelligent wearable platform conceived to integrate multimodal sensing, artificial intelligence, digital twin technology, and soft robotics for personalized hand rehabilitation. The system architecture combines sensor-based acquisition of functional and biomechanical variables with data processing algorithms designed to characterize movement patterns and support adaptive rehabilitation strategies. A digital representation of hand performance is proposed to enable longitudinal monitoring and individualized adjustment of therapeutic assistance, while soft robotic components provide adaptable mechanical support during functional exercises. The platform also incorporates remote monitoring capabilities to facilitate follow-up outside specialized clinical environments. EXO-RA SmartHand® represents an interdisciplinary approach connecting smart sensing systems, wearable electronics, artificial intelligence, and rehabilitation engineering, with potential applications in personalized management of rheumatoid arthritis-related hand disability.

Keywords: Multimodal sensing; wearable systems; artificial intelligence; soft robotics; digital twin.

ICEMSET-2026/FS/INV/214

Toward a Sustainable Future: Eco-Friendly Lead-Free Ferro/Piezoelectric Ceramics

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Abstract

The rapid expansion of consumer electronics has generated critical environmental concerns regarding the widespread use of lead-based ferro/piezoelectrics, which possess high toxicity and strict regulatory restrictions. This study investigates the development of lead-free ferro/piezoelectric ceramics as viable, sustainable alternatives to industry-standard lead zirconate titanate (PZT). We synthesize potassium sodium niobate (KNN) and barium calcium zirconate titanate (BCZT)-based perovskite ceramics using a conventional solid-state reaction method to evaluate their structural, dielectric, and ferro/piezoelectric properties. Experimental results demonstrate that optimizing the chemical composition near the morphotropic phase boundary yields excellent structural and functional properties required for commercial applications. Furthermore, a life cycle assessment confirms ~ 65% reduction in environmental toxicity during production and disposal compared to lead-based manufacturing. These findings demonstrate that lead-free ferro/piezoelectric ceramics can achieve high-performance metrics while satisfying global green electronics regulations, offering a clear pathway toward a sustainable future in electronic device manufacturing.

Keywords: Lead-free ceramics; KNN; BCZT; Ferro/piezoelectrics; Life cycle assessment (LCA).

ICEMSET-2026/FS/INV/215

Artificial Intelligence in the era of Quantum Computing

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Abstract

Artificial Intelligence (AI) is the ability of machines to perform intelligent tasks, which, normally only intelligent human beings can do. Nowadays, AI is ubiquitous. It touches all aspects of human life including

banking and finance, health care, travel and tourism, education, warfare, recreation, and sports. Recently, Generative AI (Gen AI) has developed a lot. Gen AI can create content of different types, including text, audio/video, documents, presentations, and most important for IT professionals, Code. Complete undergraduate projects can be created very quickly using Gen AI. This does affect the job market for engineers, especially, at the entry level. Graduating students need AI and Gen AI skills. They need to be well versed with the Gen AI tools used in their field of engineering. However, they should know the traditional aspects of theit field very well as well. They will have to use the knowledge to inspect the content created by Gen AI and tweak them to perfection. Quantum Computing is an emerging field. Quantum Computing courses are taught at the undergraduate level these days. There are some Universities in Bangalore offering degrees in Quantum Computing.Quantum Computing uses the unique qualities of quantum mechanics to solve problems beyond the ability of even the most powerful classical computers. The field of quantum computing includes a range of disciplines, including quantum hardware and quantum algorithms. Quantum computing is still in development. However, quantum technology will soon be able to solve complex problems that even classical supercomputers cannot solve fast. By taking advantage of quantum physics, large-scale quantum computers would be able to tackle certain complex problems many times faster than modern classical machines. Quantum computers have the potential to solve certain problems in minutes or hours that would otherwise take conventional machines millennia to complete. Quantum Computing has applications in pharmaceuticals/drug discovery, chemistry, and Machine Learning. Gen AI can be used to discover better quantum algorithms. These algorithms, in turn, can be used to drive faster AI. A very important use is finding drugs and cures for diseases like cancer and HIV.

ICEMSET-2026/FS/INV/217

Sensors in Drones and Unmanned Aerial Systems: Enabling Intelligent Perception, Navigation and Autonomous Operations

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Abstract

Drones and Unmanned Aerial Systems (UAS) are rapidly evolving from remotely operated platforms into intelligent, autonomous systems capable of perception, navigation, decision-making and mission execution. Sensors form the foundation of this transformation by enabling the drone to understand its environment, estimate its position and motion, maintain flight stability, and acquire mission-specific data. This keynote provides an overview of the major sensor technologies used in modern drones, including IMU, accelerometer, gyroscope, magnetometer, barometer, GNSS/GPS, optical flow, cameras, LiDAR, ultrasonic and range sensors. The lecture discusses their working principles, sensor fusion, calibration, data acquisition and practical applications in navigation, obstacle avoidance, mapping, inspection, agriculture, surveillance and autonomous operations. Emphasis will also be placed on emerging trends such as AI-enabled perception, edge computing, multi-sensor fusion and intelligent autonomous flight, highlighting opportunities for research and innovation.

Keywords: Drones; Unmanned Aerial Systems; Sensors; Sensor Fusion; Autonomous Navigation.

ICEMSET-2026/FS/INV/219

Genetically Programmable Protein Nanowire–Polymer Composites for Sustainable Bioelectronics and Electrochemical Sensing

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Abstract

The development of sustainable and multifunctional electronic materials is essential for emerging bioelectronics, flexible sensors, and environmentally compatible electronic technologies. In this study, we developed conductive biomaterial composites by integrating genetically engineered microbial protein nanowires (ePNs) with polyvinyl butyral (PVB). The protein nanowires provide an electrically conductive biological component, while the polymer matrix offers mechanical robustness and water stability. The electrical properties of the

resulting composites were systematically tuned by controlling nanowire loading and genetically modifying the aromatic amino acid composition of the protein nanowires, demonstrating molecular-level control over material functionality. Structural and electrical characterization revealed the formation of interconnected conductive networks within the polymer matrix with stable charge-transport characteristics. Importantly, *Escherichia coli* cells expressing conductive protein nanowires could be directly incorporated into the polymer matrix, eliminating the requirement for nanowire purification and providing a simplified and potentially scalable fabrication strategy. The resulting composites retained electrical conductivity under aqueous conditions and could be genetically programmed to display analyte-specific peptide ligands, enabling their application as selective electrochemical sensing platforms. This approach combines biological synthesis, genetic programmability, polymer engineering, and electrical functionality to create sustainable conductive materials. The developed protein nanowire–polymer platform offers opportunities for next-generation bioelectronics, flexible sensing devices, and environmentally sustainable electronic materials.

Keywords: Protein nanowires; Genetically engineered nanowires; Conductive biomaterials; Polymer composites; Bioelectronics; Electrochemical sensing; Sustainable materials.

ICEMSET-2026/FS/INV/220

Enhanced cycling performance and thermal stability of core-shell structured cathode materials for Li-ion batteries

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Abstract

Li-ion batteries have dominated the portable electronic device market, because of their high energy density above 200 Wh kg^{-1}, and good cycling stability. Lithiated Ni-rich oxides (LNRO) exhibiting high capacity above 200 mAh g^{-1} are promising cathode materials for Li-ion batteries. However, they suffer from various challenges including structural change, oxygen evolution, and micro-crack formation upon prolonged cycling. Herewith, a core–shell material 0.8 $LiNi_{0.85}Mn_{0.10}Co_{0.05}O_2$–0.2 $Li_{1.2}Ni_{0.16}Mn_{0.56}Co_{0.08}O_2$ (NR-CS) is developed consisting of a Ni-rich oxide core of $LiNi_{0.85}Mn_{0.10}Co_{0.05}O_2$ (NMC85) and an outer shell of a Mn-based Li-rich $Li_{1.2}Ni_{0.16}Mn_{0.56}Co_{0.08}O_2$ oxide, which can deliver an initial discharge capacity of 212 mA h g^{-1} when cycled at 20 mA g^{-1} (0.1C rate) in the potential range of 2.8–4.3 V vs. Li. The NR-CS material can retain 89% capacity after 120 cycles when tested vs. Li anodes. The core–shell structure gets benefitted from the high specific capacity of the core Ni-rich oxide NMC85 and surface chemical stability of the Li-rich Mn-based oxide. Moreover, when tested in full Li-ion cells, pre-lithiated graphite‖NR-CS cells provide a discharge capacity of about 170 mA h g^{-1} and an energy density of 274 W h kg^{-1} during 200 cycles when cycled at 0.5C rate.

Keywords: Ni-rich oxides; core-shell; micro-crack; capacity fading; thermal stability.

ICEMSET-2026/FS/INV/221

Synthesis, Structural, Dielectric, Ferroelectric and Magnetoelectric studies of Sodium Potassium Niobate and Cobalt Ferrite Multiferroic Composites

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Abstract

Lead free magnetoelectic composites of Sodium Potassium Niobate, $Na_{0.5}K_{0.5}NbO_3$(NKN) and Cobalt Ferrite, $CoFe_2O_4$(CFO) of the chemical formula (1-x)NKN-(x)CFO.These composites are triphasic compounds because NKN is a combination of ferroelectric $KNbO_3$ and antiferroelectic $NaNbO_3$ and CFO is ferromagnetic. The composites for x =0.00, 0.20, 0.40, 0.50, 0.60, 0.80 and 1.00 are synthesized by solid state reaction method XRD studies confirm the existence of both orthorhombic phase of NKN and spinel cubic phase of CFO. FTIR studies confirm the presence of vibrational and stretching bonds which confirm the formation of composites.SEM gives the morphology and average grain size. EDS studies give the presence of elements in

composites. Dielectric studies are studied and confirm the temperature dependent dielectric properties of the composites. Piezoelectric coefficient (d_{33}) and resistivity measurements studies show the decrease in their value as CFO component increases. The PE studies confirm the composites become conductive as the ferrite component increases. The magneto electric studies are done and magnetoelectric voltage coefficient is maximum for 60percenetage of NKN compound.

Keywords: Ferroelectrics, dielectric constant, Composites, magnetoelectric coefficient, piezoelectric coefficient.

ICEMSET-2026/FS/INV/222

Biochar as a Pathway to Carbon Sequestration: Production, Properties, Climate-Mitigation Applications, Challenges, and Future Perspectives

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Abstract

Biomass is thermo chemically transformed in an oxygen-limited atmosphere, a porous, carbon-rich material known as biochar is produced. It has garnered increasing scientific, policy, and economic interest as a multifunctional strategy for carbon sequestration, soil fertility enhancement, greenhouse gas reduction, waste valorization, and environmental remediation. With an emphasis on studies and policy changes from 2024–2026, this review highlights recent research on biochar production pathways, physicochemical characteristics, carbon stabilization mechanisms, uses in mitigating climate change, and major deployment problems. Feedstock type and processing temperature have a major impact on carbon content, aromaticity, porosity, pH, cation exchange capacity, nutritional availability, contaminant risk, and long-term stability. Gasification, torrefaction, hydrothermal carbonization, and slow, rapid, and flash pyrolysis are methods for producing biochar. Recent assessments indicate that biochar systems may contribute at gigaton scale to climate mitigation, despite the fact that estimates vary widely due to variations in biomass availability, system constraints, economic assumptions, and inclusion or exclusion of avoided emissions and energy co-products. The climate significance of biochar is attributed to a number of factors, including the direct storage of persistent pyrogenic carbon, reduced breakdown of native soil organic carbon, increased plant productivity, moderation of nitrous oxide and methane emissions in some soils, and displacement of fossil energy when syngas or bio-oil is recovered. Large-scale implementation is hampered by a number of factors, including feedstock competition, production costs, inconsistent agronomic responses, contaminant risks, unpredictable long-term field performance, monitoring and verification requirements, and still-evolving frameworks for carbon credits and policies.

Keywords: Biochar; carbon sequestration; pyrolysis; climate change mitigation; soil fertility; greenhouse gases; carbon dioxide removal; circular economy; soil remediation; negative emissions.

ICEMSET-2026/FS/INV/223

ML-Augmented CFD-Framework for Heat-Sink and Fan-Speed Optimization in Gaming Workstation

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Abstract

This study presents a system-level Computaionl Fluid Dynamics (CFD) -based modeling and optimization of a 328 W gaming workstation's GPU cooling system. A multi-objective Particle Swarm Optimization (MOPSO) algorithm is employed to minimize the maximum GPU temperature (T_{GPU}) and the total cooling-system cost (C_{total}). Design variables include longitudinal fin count $N_L \in [10,70]$, transverse fin count $N_T \in [10,45]$, fin shape $S_{fin} \in$ {Cylindrical, Frustum, Square}, heat-sink material $M_{hs} \in$ {Al,Cu,SiC}, and fan speed $V_{fan} \in$

{1000,2000,3000} RPM. T_{GPU} obtained from CFD solutions is used to train artificial neural networks (ANN) model. The trained ANN predicts T_{GPU} and C_{total} for parameter combinations generated via MOPSO. Pareto-optimal solutions illustrate trade-offs between temperature and cost with the optimal configuration of NL = 65, NT = 40, Sfin = Square, Mhs = Cu, Vfan = 3000 achieved TGPU = 69.90◦C and Ctotal = INR2082.93. Compared to baseline, the optimized design reduced maximum temperature by 24.24%.

Keywords: Thermal Management of Electroinic Devices, Heat Transfer, Heat Sink, Artificial Neural Network, Computaionl Fluid Dynamics.

ICEMSET-2026/FS/INV/226

Silica-Reinforced Polyborodimethylsiloxane: Concentration-Dependent Shear Thickening and Rheological Behaviour

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Abstract

Polyborodimethylsiloxane (PBDMS) exhibits unique viscoelastic characteristics arising from reversible boron–oxygen interactions within its polymer network. In the present study, silica was incorporated into PBDMS at varying concentrations to investigate its influence on the rheological behaviour of the resulting composites. The effect of silica loading on flow behaviour and shear response was systematically evaluated through rheological measurements. The incorporation of silica significantly modified the viscoelastic response of PBDMS, with increasing silica concentration leading to a progressive enhancement in shear-thickening behaviour. This response is attributed to the formation of a stronger, more interconnected polymer–silica network and to increased resistance to flow under applied shear. The observed concentration-dependent rheological response demonstrates the potential of silica-reinforced PBDMS for applications requiring tunable rate-dependent mechanical behaviour and enhanced energy dissipation.

Keywords: Polyborodimethylsiloxane (PBDMS); Silica reinforcement, Shear thickening, Rheological properties, Viscoelasticity, Polymer-silica interaction, Shear-dependent behaviour, Energy dissipation.

ICEMSET-2026/FS/INV/228

AI-Enabled Sensors, MEMS and Smart Systems for Real-Time Healthcare Monitoring of Elderly Patients

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Abstract

As the elderly population has been rising, the demand for innovative, reliable, and accessible healthcare solutions has also grown, that allow continuous monitoring and timely intervention. The use of sensors, Micro-Electro-Mechanical Systems (MEMS), and smart technologies presents tremendous potential for revolutionizing the care of elderly individuals by enabling real-time health monitoring, early detection of health risks, and personalized healthcare. This paper investigates the use of sensor and MEMS based smart system for monitoring elderly patients' critical health parameters and daily actions. The proposed approach combines wearable and non-invasive sensors, Internet of Things (IoT) connectivity and intelligent data analysis for the monitoring of vital signs, physical activity, mobility and potential emergencies like falls. The system can facilitate remote communication between patients, caregivers, and healthcare professionals, enabling faster responses and improved decision-making. The study demonstrates the synergy that can be achieved by miniaturizing the

sensing technologies and utilizing them in smart healthcare applications to enhance patient safety, independence, quality of life, and the efficiency of elderly care delivery.

Keywords: Elderly, Healthcare, sensor, MEMS, Artificial Intelligence.

ICEMSET-2026/FS/INV/229

Energy Harvesting Characteristics of Lead-Free Piezocomposites Using Electromagnetic Radiation Technique

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Abstract

The need for harnessing energy from different sources to fulfil human need is considered the most pressing concern in the recent past. Efforts are being made worldwide nowadays to effectively utilize the waste energy from different sources viz. human motion, solar, heat, light etc. that are generally wasted into electrical energy. In this context, lead zirconate titanate (PZT) has been explored thoroughly due to its superior piezoelectric properties and energy harvesting capability. However, increasing environmental and health concerns associated with this lead based ceramic have paved the way for the development of lead-free piezoelectric composites. Further, conventional piezoelectric energy harvesting technique require the installation of a large number of PZT patches on the structures. To address this concern, electromagnetic radiation (EMR) technique has attracted considerable attention as an effective tool for harnessing energy using lead-free piezocomposites. The findings obtained from various piezoceramics viz. PZT, PVDF, PVDF/NBT, PVDF/BCZT, cement/PZT, cement/BNBT etc. using EMR technique pave the way for the development of eco-friendly sustainable lead-free piezoelectric composites for next-generation wireless energy harvesting applications.

Keywords: Lead-free piezoceramics, EMR, energy harvesting.

ICEMSET-2026/FS/INV/230

Rydberg-Atom Quantum Antennas: Principles, Characteristics, Applications, and Challenges

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Abstract

In the technological era, quantum antenna is one of the emerging tool for facilating wireless communications as well as detecting electromagnetic (EM) fields. These systems can detect and identify millimeter-wave, microwave, radio-frequency, and even terahertz fields by the directly coupling of EM fields to quantum states thru the use of highly excited atomic states, large electric-dipole moments, and resonant transitions. The Rydberg-based receivers exhibits numerous exotic properties like polarisation sensitivity, frequency tunability, electrical small sensing, and detection of both amplitude and phase, which leads to the advancement in the field of multiple input–multiple output structures, antenna-free devices, hybrid-quantum receivers, and the formation of synthetic structures. Despite these advancements, there have not yet been effective solutions proposed for a few fundamental challenges, like decoherence and signal-to-noise ratio, optical constraints, scalability, EM coupling, etc. Here, in this paper an overview of Rydberg-atom quantum antenna concepts, designs, features, uses, limits along with the possible ways to develop the technology further to meet quantum-enabled electromagnetic sensing and next-generation radio systems are briefly discussed.

Keywords: Rydberg atom, Antenna, Terahertz, Quantum Sensing.

ICEMSET-2026/FS/INV/231

Tailoring Morphologies of $ZnFe_2O_4$ Nanomaterials for High Performance Supercapacitors

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Abstract

Utilizing an autoclave-assisted method, zinc ferrite ($ZnFe_2O_4$) nanostructures with a variety of morphologies were effectively prepared by tailoring the synthesis conditions while maintaining a fixed precursor composition. The impact of various structure-directing agents on $ZnFe_2O_4$ morphology was thoroughly examined. SEM was used to characterize morphological evolution, while XRD was used to confirm the structure. The electrochemical analysis was evaluated by means of GCD and analysis. $ZnFe_2O_4$ yielded with the aid of oxalic acid had the highest specific capacitance of 385 F/g within the potential window of 0 to 0.55 V at 1 A/g and showed a well-aligned stacked rodlike morphology among the prepared samples. The stacked rod's directional structure, which enables ions to move swiftly and store charge effectively, is responsible for its enhanced electrochemical performance. This work establishes $ZnFe_2O_4$ as a promising electrode for scalable, high-performance supercapacitor applications.

Keywords: Zinc Ferrite; Morphology; Structure Directing Agent; Electrode; Supercapacitor.

ICEMSET-2026/FS/INV/232

AI-Driven Biomedical Sensors and Wearable Technologies for Smart Healthcare

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Abstract

The rapid convergence of artificial intelligence (AI), biomedical sensors, wearable technologies, and connected healthcare systems is transforming the way of monitoring, predicting and managing health conditions. AI-driven biomedical sensors can continuously acquire biochemical parameters such as blood oxygen saturation and physiological parameters such as heart rate, , temperature, blood pressure, and other health parameters. Machine learning algorithms help intelligent interpretation of complex and real-time health data. This talk covers emerging developments in wearable and non-invasive sensing technologies, IoT-enabled healthcare, edge intelligence, and AI-assisted decision support for personalized and preventive healthcare. Integration of sensing, signal processing, connectivity, and AI for early detection of abnormalities, remote patient monitoring, and intelligent health management will be discussed. The challenges related to sensor reliability, data quality, interoperability, privacy, energy efficiency, and clinical validation, along with future opportunities for developing affordable, accessible, and intelligent healthcare solutions are also explored in this talk.

Keywords: Artificial Intelligence, Biomedical Sensors, Wearable Technologies, Smart Healthcare, IoT, Machine Learning, Remote Patient Monitoring.

ICEMSET-2026/FS/INV/233

Numerical Investigation of Thermomagnetic Convection in Ferrofluid Based Cooling System

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Abstract

The demand for energy-efficient thermal management in compact electronics and industrial machinery has driven interest in passive cooling solutions that overcome the noise, vibration, and leakage risks of mechanical pumps. Ferrofluids-colloidal suspensions of magnetic nanoparticles-offer a self-driven alternative by exhibiting

thermomagnetic convection under simultaneous thermal and magnetic gradients. This study presents a numerical investigation of ferrofluid flow in a closed-loop configuration using COMSOL Multiphysics to evaluate the feasibility of a pump-free thermal management system. A two-dimensional geometrical model was built to evaluate the potential of such a cooling device. The system was subjected to constant heat flux and permanent magnet was positioned near the heat source to provide thrust force for movement of the ferrofluid. Under a 0.5T magnetic field, magnetic forces induced fluid motion with a peak velocity of 14.9 mm/s, thereby significantly enhancing heat transfer performance, particularly when the ferrofluid operates near its Curie temperature and permanent magnets are positioned midway across the heat source. These findings demonstrate that ferrofluids are promising coolants for thermal applications, enhancing heat dissipation while reducing operating energy requirements.

Keywords: Passive Cooling Device, Numerical Investigation, Ferrofluid, Heat transfer augmentation, Thermo-magnetic convection.

ICEMSET-2026/FS/INV/235

Reconfigurable Intelligent Surface-assisted Wireless Communication for 6G and Beyond

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Abstract

One essential component of 6G wireless networks is terahertz communication. It provides incredibly high data rates and enormous bandwidth. Nevertheless, THz signals are highly sensitive to obstructions and have a significant propagation loss. This issue is resolved by intelligent reflecting surfaces, or IRS. They construct intelligent, reconfigurable radio links and mold the wireless environment using inexpensive passive components. Addressing substantial path loss and molecular absorption in the THz band, optimizing spectrum and energy efficiency by combining active and passive beamforming, handling discrete reflection amplitude models and low-resolution phase changers, enabling dynamic 6G scenarios with ultra-reliable low-latency communication (URLLC) are the cutting-edge areas of research. The phase update of the IRS elements can be done by optimization methods such as gradient discent (GD), genetic algorithm (GA) etc which maximizes the received signal power.

Keywords: 6G; IRS; URLLC; GD; GA.

ICEMSET-2026/FS/INV/236

Polymeric Materials Constitute

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Abstract

Polymeric materials constitute one of the most versatile classes of engineering materials and play a vital role in modern technology due to their lightweight nature, cost-effectiveness, ease of processing, and excellent mechanical, electrical, thermal, and chemical properties. This talk will provide an overview of the fundamental structure and classification of polymers, including thermoplastics, thermosets, and elastomers, along with their synthesis, characteristics, and performance. The session will also highlight the significance of polymeric materials in engineering applications, particularly in electronics and communication systems, such as insulating materials, printed circuit boards, optical fibers, flexible electronics, and advanced composites. Recent developments in smart polymers, biodegradable polymers, and nanocomposite materials will be discussed to emphasize emerging trends and future opportunities. The presentation aims to enhance understanding of polymer science and its growing impact on sustainable and high-performance engineering solutions.

Keywords: Polymeric materials; thermoplastics; thermosets, elastomers.

ICEMSET-2026/FS/INV/237

From Semiconductor-Enabled Sensing to Edge Intelligence: AI-Driven Architectures for Next-Generation Smart Electronic Systems

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Abstract

The convergence of semiconductor-enabled sensing, embedded computing, wireless communication, and artificial intelligence is enabling a new generation of smart electronic systems capable of real-time interpretation and autonomous decision-making. This invited talk presents an integrated architecture combining intelligent sensors, embedded processors, edge-AI models, RF/wireless interfaces, and cloud-connected platforms for low-latency, context-aware applications. The discussion highlights practical design considerations including sensing reliability, computational efficiency, power constraints, communication latency, security, and scalable device integration. Representative applications include intelligent healthcare devices, environmental and tree-health monitoring, high-precision localization, portable detection systems, and IoT-enabled sensing platforms. The talk emphasizes how semiconductor-enabled electronics, when coupled with edge intelligence and AI-driven signal interpretation, can evolve from conventional data acquisition platforms into adaptive, connected, and deployable intelligent systems for emerging scientific and engineering applications.

Keywords: Semiconductor-enabled sensing; Edge AI; Embedded intelligent systems; Intelligent sensors; IoT.

ICEMSET-2026/FS/INV/238

Recent Development of Mechanical Applications of Magnetorheological Elastomer

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Abstract

Magnetorheological elastomers (MREs) are smart composite materials consisting of ferromagnetic particles dispersed within an elastomeric matrix. Their ability to reversibly modify stiffness, damping, and viscoelastic behavior under an external magnetic field has attracted significant attention for adaptive mechanical systems. Unlike magnetorheological fluids, MREs eliminate issues related to sedimentation, leakage, and sealing while offering rapid response, excellent durability, and structural stability. This paper reviews recent developments in the mechanical applications of MREs with emphasis on advancements reported over the last decade. The review discusses fabrication methods, material classifications, magnetic field-dependent mechanical properties, and constitutive modeling approaches. Recent mechanical applications including vibration absorbers, adaptive vibration isolators, engine mounts, base isolation systems, smart machining fixtures, polishing tools, robotic actuators, adaptive grippers, sensors, biomedical devices, and aerospace structures are critically reviewed. Emerging applications in composite machining, intelligent manufacturing, and Industry 4.0 are highlighted. The paper also identifies existing challenges related to magnetic saturation, long-term durability, thermal stability, optimization of particle distribution, and large-scale industrial implementation. Finally, future research directions including hybrid MRE composites, machine learning-assisted design optimization, multifunctional smart structures, and digital twin-based adaptive systems are discussed. This review provides researchers and practicing engineers with an updated understanding of recent progress and future opportunities in MRE-enabled mechanical systems.

Keywords: Magnetorheological elastomer; smart material; mechanical applications; base isolator; vibration control.

ICEMSET-2026/FS/INV/239

Study of the gas sensing properties of reduced graphene oxide samples

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Abstract

Gas sensors play a vital role in numerous application fields of environmental protection, industrial manufacturing, medical diagnosis, and national defence. The past several decades have witnessed a tremendous development of gas sensors based on chemical sensing in many fields. Various reduced graphene oxide sample (thermally, chemically and multistep) are prepared. The Raman spectra of the prepared sampes consists of the characteristics peak of D and G bands at 1360 and 1590 cm^{-1}, respectively. The reduction of GO is estimated on the basis of Tuinstra and Koenig relation. It is observed that with increase inextent of reduction, the graphitic domain or crystallite size decreases and intensity ratio increases. The elimination of functional groups are further confirmed by the FT-IR spectra of prepared samples. The SEM micrographs of the GO sample consist of aggregated sheet type structure which keeps on converting into individual graphene sheets after reduction. The TEM micrographs of the all the samples consists of sheet type structures. The specific surface area of the prepared samples is measured with the help of BET measurement technique. The specific surface of GO is found to be 64.17 m^2/g which increases to 612.96 m^2/g in the reduced sample. The electrical gas sensing responses of the differently reduced rGO have been observed in SO_2 environment. The gas sensing response is found to be selective and high during reduction.

Keywords: Graphene, Gas sensing, Raman Spectroscopy, Specific surface area, Scanning electron microscopy.

ICEMSET-2026/FS/INV/240

A Staged Computational Framework for Absorption Cross-Section and Internal Electromagnetic Energy in Magneto-Optical Fe_3O_4 Microspheres

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Abstract

Predicting the optical response of magnetic microspheres requires accurate internal-field computation alongside far-field scattering quantities, yet many Mie-based treatments of Fe_3O_4 systems report absorption cross-sections without validating the underlying internal electromagnetic energy density. This work presents a staged computational pipeline that sequentially derives field-dependent Mie coefficients, reconstructs internal electromagnetic energy distributions, and computes absorption cross-sections for Fe_3O_4 microspheres, allowing each stage to be validated independently before propagating to the next. The staged approach isolates numerical inconsistencies otherwise masked when cross-sections are computed directly from coefficients alone. Applying this framework across a range of particle sizes and magnetic field strengths yields absorption spectra consistent with expected resonance behavior while exposing sensitivity in the internal-field stage that direct cross-section calculations do not capture. The framework offers a transparent, verifiable route to modeling magneto-optical absorption in iron-oxide microspheres, with direct relevance to sensor and photonic device design.

Keywords: Mie scattering, Fe_3O_4 microspheres, absorption cross-section, internal electromagnetic energy, magneto-optics, computational electromagnetics.

ICEMSET-2026/FS/INV/241

Ultra-Compact Multiband Metasurface Absorber for Advanced Healthcare Sensing Applications

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Abstract

Wearable and implantable healthcare devices increasingly demand compact electromagnetic components that can operate reliably across several frequency bands. This study presents an ultra-compact multiband metasurface absorber developed for advanced healthcare sensing applications. A miniaturized resonator element is printed on a thin, low-profile substrate to achieve strong, polarization-insensitive absorption at multiple microwave frequency bands while keeping the overall footprint small enough for integration with wearable and biomedical platforms. The design was modelled and analysed using full-wave electromagnetic simulation, and its absorption behaviour was examined under varying polarization and oblique incidence angles. The results show absorption efficiency exceeding 90% at the targeted resonant frequencies, together with stable performance across a wide range of incidence angles. These findings indicate that the proposed metasurface offers a compact, angularly stable, and multiband alternative to conventional absorber designs, making it well suited for non-invasive healthcare monitoring and biosensing applications.

Keywords: Metasurface Absorber; Multiband Absorption; Healthcare Sensing; Polarization-Insensitive; Microwave Metamaterial.

ICEMSET-2026/FS/INV/242

Defect Detection and Quality Assurance in 3D-Printed Polymer Composite Materials: Effect of Carbon-Fiber Reinforcement and Thermal Post-Curing on Mechanical Performance

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Abstract

The present study investigates the effects of carbon-fibre reinforcement and thermal post-curing on the mechanical performance and defect characteristics of FDM-printed polymer composites. Four materials—PLA, PLA/CF, ABS, and ABS/CF—were fabricated under controlled printing conditions. Tensile and impact tests were conducted according to ASTM D638 and ASTM D256, respectively, while SEM examined fracture morphology and fibre–matrix interaction. Specimens were evaluated in as-printed and post-cured conditions. In the as-printed state, PLA/CF exhibited the highest tensile strength (74.5 N/mm²), followed by PLA (44 N/mm²), ABS/CF (37 N/mm²), and ABS (34 N/mm²). ABS-based materials showed higher impact strength than PLA-based materials. Post-curing substantially improved the tensile strength of ABS/CF and ABS, while its effect on PLA/CF was limited. Impact strength increased for PLA and PLA/CF from approximately 1.0 to 3.3–3.4 J but decreased for ABS and ABS/CF. SEM revealed reduced porosity, improved fibre–matrix adhesion, and increased fibre fracture after curing. The results highlight the matrix-dependent effectiveness of reinforcement and post-processing.

Keywords: Fused deposition modelling; 3D printing; PLA; ABS; carbon fibre; polymer composites; Fractography.

ICEMSET-2026/FS/INV/243

Customization of Structural and Electronic properties of Au^{9+} Implanted MoS_2 Thin Films by Low-Energy Ion Implantation Technique

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Abstract

Two-dimensional MoS_2 a class of Transition metal dichalcogenides (TMDs) with extra-ordinary physical and chemical peculiarities is a promising candidate due to its layered structure, high conductivity, and fast charge transfer kinetics. Sputtered MoS_2 films were irradiated with 70 KeV Au^{9+} ion beam with a fluence of 1×10^{13} and 2×10^{13} ions-cm^{-2} to investigate the atomic-level defect assisted electronic changes in MoS_2 thin films. Gold ion beam with 70KeV energy was used to have an apparent impact on structural, electronic and optical

properties of MoS_2 thin films. The structural identity of the film has been confirmed by X-ray diffraction and Raman spectroscopy, the A_{1g} and E^1_{2g} peak position indicate a few MoS_2 layers. Vacancy related defect engineering by Au^+ ion implantation is shown to effectively tune MoS_2 thin films as analysed by photoluminescence spectroscopy. The lower fluence i.e. 1×10^{13} ions-cm^{-2}, leads to have more defects density with less crystallinity but increase in electrical conductivity. The higher fluence i.e. 2×10^{13} ions·cm^{-2} induces recrystallization with slight decrease in electrical conductivity. The ion implantations demonstrate that the moderately implanted molybdenum disulphide is very promising for high-performance applications in optoelectronics devices and Nano electronics e.g. field-effect transistors (FET).

Keywords: MoS_2, Ion Implantation, Defects Engineering, Electrical Conductivity.

ICEMSET-2026/FS/INV/244

Computational and Experimental Evaluation of Antibacterial Efficacy and Safety Profiles of Ethanol and Chloroform Extracts of *Ayapana triplinervis* in Nile Tilapia (*Oreochromis niloticus*)

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Abstract

Streptococcosis due to *Streptococcus agalactiae* severely impacts global aquaculture, while antibiotic overuse exacerbates antimicrobial resistance. This study compared the phytochemical composition, antibacterial activity, in silico cytolysin E binding, and toxicity of ethanol versus chloroform leaf extracts of *Ayapana triplinervis* in Nile tilapia. Soxhlet extraction yielded 8.5% (ethanol) and 3.5% (chloroform) extracts. GC-MS revealed ethanol extract contained unique bioactives including lupeol, higher ayapanin (6.29% vs. 4.28%), and elevated fatty acids. Ethanol extract exhibited four-fold superior antibacterial activity (MIC: 1 µL/mL) versus chloroform (MIC: 4 µL/mL). Molecular docking demonstrated ethanol-extract compounds had higher cytolysin E binding affinities (−8.8 to −8.4 kcal/mol), with lupeol acetate as a high-affinity binder. Acute toxicity (96-hour feeding at 0.4–250 mL/kg feed) showed 100% survival for both; however, ethanol extract caused no behavioral, hematological, histopathological, or biochemical alterations, whereas chloroform induced dose-dependent changes. Ethanol extract emerges as a safer, computationally supported phytotherapeutic candidate against streptococcosis.

Keywords: *Ayapana triplinervis*, Ethanol & chloroform extract, *Streptococcus agalactiae*, Nile tilapia, Molecular docking.

ICEMSET-2026/FS/INV/245

Liquid Crystal-Based Optical Sensing: From Molecular Recognition to Practical Applications

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Abstract

Liquid crystals provide a unique and highly sensitive interface for transducing molecular recognition events into readily detectable optical changes. Due to their sensitivity to interfacial interactions and surface induced reorientation, they offer intrinsic optical anisotropy and interfacial responsiveness that can be exploited to develop ultracompact sensing platforms that are simple, inexpensive and amenable to rapid analysis. In this presentation, I will focus on our recent efforts to develop liquid crystal-based microchip sensors for detecting environmentally hazardous chemicals, toxic metal ions, and clinically relevant biomarkers. The sensing strategy is based on selective molecular recognition together with target-induced reorganization of the liquid crystal molecules at the interface, leading to a direct and visual-accessible optical readout. These studies illustrate the

versatility of liquid crystal technology as a promising approach toward portable, low-cost and field deployable systems for environmental monitoring and point-of-care diagnostics.

Keywords: Liquid crystals; Interfacial sensing; Optical transduction; Molecular recognition; Environmental monitoring; Biosensing; Point-of-care diagnostics.

ICEMSET-2026/FS/INV/246

Coexistence of Magnetism and Superconductivity in Iron-Based Superconductors: Theoretical Perspectives and Emerging Materials

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Abstract

The coexistence and interplay of magnetism and superconductivity in correlated electronic systems remain important problems in condensed-matter physics. Iron-based superconductors provide a particularly interesting platform in which superconductivity emerges in close proximity to antiferromagnetic order, while competing and coexisting magnetic states can strongly influence the superconducting properties. In this talk, I will discuss theoretical aspects of the coexistence of antiferromagnetism, ferromagnetism and superconductivity in iron-based superconducting systems. Particular emphasis will be placed on the role of magnetic interactions, superconducting order parameters and their mutual coupling in determining the electronic properties and critical temperature. I will also discuss how these theoretical perspectives contribute to our understanding of emerging electronic and quantum materials, including low-dimensional and strongly correlated systems. Finally, possible connections between theoretical modeling and computational approaches for designing and exploring novel functional materials will be highlighted.

Keywords: Iron-based superconductors; Magnetism; Superconductivity; Coexistence; Quantum materials.

ICEMSET-2026/FS/INV/247

Growth and Characterization of $LaAlO_3/SrTiO_3$ and $LaTiO_3/SrTiO_3$ oxide hetero-structure using PLD

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Abstract

High mobility two-dimensional electron gas (2DEG) at $LaAlO_3/SrTiO_3$ is significantly vital for the oxide electronics devices. Here, we report the fabrication and characterization of varies thickness samples of $LaAlO_3$ /$SrTiO_3$ and $LaTiO_3/SrTiO_3$ hetero-structures having high crystalline quality. All the samples were epitaxially grown on $SrTiO_3$ (001) substrate by Pulser Laser Deposition (PLD). In- situ RHEED oscillations and diffraction patterns and Ex-situ XRD techniques were employed to confirm the epitaxial nature and crystalline quality of all the samples. our samples exhibit the properties of 2DEG at the interface. For $LaXO_3/SrTiO_3$ (X=Al, Ti) samples, linear Hall voltage was observed and temperature dependent carrier concentration and mobility was measured. Our results in this study are beneficial to understand the advantages of PLD method equipped with RHEED and refers that PLD is one of the versatile methods to prepare high-quality oxide samples.

Keywords: oxide hetero-structures, 2DEG, PLD.

ICEMSET-2026/FS/INV/248

Engineering Electrospun Biopolymeric Nanofibres for Controlled Delivery of Dietary Bioactives: From Material Design to Functional Food Applications

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Abstract

Electrospinning offers a versatile approach for engineering functional nanofibrous materials with high surface-area-to-volume ratio, tunable morphology, and controlled mass-transfer characteristics. This work explores pullulan–pectin-based electrospun nanofibres as food-grade matrices for stabilization and controlled delivery of dietary bioactives. The influence of polymer characteristics and electrospinning conditions on fibre formation, morphology, and functional performance was investigated. Incorporation of bioactives into the polymeric matrix produced uniform nanofibres with effective encapsulation and improved protection against environmental and processing-induced degradation. The nanofibrous architecture facilitated modulation of diffusion and release behaviour under simulated gastrointestinal conditions, demonstrating the potential for controlled bioactive delivery. Incorporation of bioactive-loaded nanofibres into milk further demonstrated their applicability in functional food systems with minimal influence on sensory characteristics. The study highlights the relationship between material design, nanoscale structure, and delivery functionality, demonstrating the potential of electrospun biopolymeric nanofibres as advanced materials for food and nutraceutical applications.

ICEMSET-2026/FS/INV/249

Graphene-Based Flexible Microstrip Antenna for Wearable Biomedical Sensing at Terahertz Frequencies

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Abstract

Terahertz (THz) technology has gained considerable attention over the past decade due to its applications in numerous fields, including communication, imaging, spectroscopy, and security. Signals in the THz range can readily penetrate biological tissue, making it suitable for biomedical applications. Conventional semiconductors such as Si-Ge, GaAs, GaN, and InP are widely used in THz electronics; however, these materials suffer from losses, leading to fabrication complexity and limited tunability, thereby encouraging the exploration of alternative materials such as graphene for THz antennas. In this work, we investigate the performance of graphene as a radiating patch for the design and analysis of a flexible, compact, and low-loss microstrip antenna on a polyimide substrate for wearable biomedical applications at THz frequencies. The performance is measured in terms of return loss, gain, efficiency, specific absorption rate (SAR), and bandwidth, and all results are simulated and validated using ANSYS HFSS software. Bending analysis is also performed to demonstrate graphene's flexibility and durability, making it a suitable candidate for wearable biomedical applications at THz frequencies.

Keywords: Graphene, THz Technology, Polyimide, Wearable Applications, Microstrip Antenna.

ICEMSET-2026/FS/INV/250

Silicon Oxycarbide for White Light Emission

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Abstract

Silicon Oxycarbide based materials are emerging as new generation materials for various high temperature structural and functional applications. It offers stability at high temperatures and a special blend of mechanical, electrical, and optical qualities. As a result, silicon oxycarbide based glass is finding a variety of applications in high voltage light emitting diodes, lithium-ion batteries, high power switching circuits, nuclear reactors, thermal protection system for aerospace applications and so on. This presentation will discuss the evolution of White LEDs. Different fabrication techniques will be explored. Further in this work, a simple sol-gel synthesis method for silicon oxycarbide glass using varying silanes will be elaborated. Characterization for phase formation and chemical structure were carried out by XRD, XPS, FTIR, Raman and EPR Spectroscopy. The photoluminescence (PL) spectra of the coated films exhibited broad spectra in the visible range.

Keywords: Silicon oxycarbide, Stoichiometry, Sol-gel, Luminescence.

ICEMSET-2026/FS/INV/252

Tuning optoelectronic properties of Si nanostructures

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Abstract

Being the most fundamental material for microelectronics, silicon (Si) has dominated more than half of the past century. However, its use in optoelectronics is limited since it has weak optical emission due to indirect bandgap. Recently, Si nanostructures have been attracting significant attention owing to their remarkable optoelectronic properties which are radically different from those of bulk crystalline Si. Thus, diversification of Si technology seems through precise control and characterization of nanostructure. In this study Si nanostructures are fabricated by using a novel technique- Laser induced chemical etching. The morphological study of these samples shows that the sizes can be tuned by controlling different etching parameters. Photoluminescence (PL) is a nondestructive tool for probing the optoelectronic properties of strongly confined nanostructures. Observation of PL in these samples confirms the presence of strong confinement. A quantitative ananlysis of the PL spectra was carried out to estimate the sizes of Si nanostructures.

Keywords: Si Nanostructures, Laser induced chemical etching, Photoluminescence.

ICEMSET-2026/FS/INV/253

Single-Step Solvothermal Synthesis of $MnFe_2O_4$/Reduced Graphene Oxide (rGO) Nanocomposites with Enhanced Electrochemical Performance for Advanced Supercapacitor Electrodes

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Abstract

We herein report on the preparation of $MnFe_2O_4$/reduced graphene oxide (rGO) nanocomposites by a facile one-step solvothermal method. The FTIR, Raman and XPS studies confirmed the incorporation of spherical $MnFe_2O4$ nanoparticles (~57 nm) in conductive 2D graphene sheets. The $MnFe_2O_4$/rGO composite was used as supercapacitor electrodes and exhibited a specific capacitance of 253 F g^{-1}, which is higher than bare nanoparticles with a specific capacitance of 133 F $g^{-}1$. The composite achieved energy density of 76.06 Wh $kg^{-}1$ and power density of 7.49 kW kg^{-1} at 10 A g^{-1}. Moreover, the electrode demonstrated excellent stability with a cyclic stability of 96% after 5,000 cycles. The results reveal that this synergistic 2D rGO nanocomposite is a very promising material for high-performance supercapacitors.

Keywords: $MnFe_2O_4$; Reduced graphene oxide; Solvothermal synthesis; Supercapacitor; Cyclic stability.

ICEMSET-2026/FS/INV/254

Environmentally friendly flexible energy producing, energy saving and thermal energy storage systems and devices- Current trends

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Abstract

The main focus of scientists all over the world as on date is on devising systems, materials, technologies, which could protect the mother earth from various types of environmental pollutions e.g. Noise pollution, water pollution, green house gases, carbon emission etc. The situation is becoming from bad to worse globally in the form of excessive rains, floods, fires in jungles, tsunamis, depleting ozone layer and so on due to global warming. The main focus in the presentation is on flexible Energy producing OPV/ OPV-perovskite solar cells, OLEDs/OLED-Perovskite light emitting diodes, displays and paraffin/graphene/coconut oil based thermal energy storage systems (TES). The presentation and the comparison will be based on the work carried out by us in our laboratory. Some light will be thrown on efficient extraction of light from organic light emitting devices and possibility of using ZnO nanorods of different radii for wave guiding action for specific active materials.

Keywords: Organic Electronics, OPV, OLEDs, Perovskites, TES.

ICEMSET-2026/FS/INV/255

Fabrication and characterization of polymeric hydrogel with cyclic peptides as efficient drug conjugates for wound healing applications

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Abstract

Hydrogels are three-dimensional hydrophilic networks that exhibit excellent structural integrity and water-holding capacity. Hydrogels mimic the extracellular matrix and show sustained drug release, promoting cell proliferation and adhesion during wound healing. The development of naturally crosslinked and biocompatible hydrogels for biomedical applications has become significant in recent years. In this study, a novel polymeric hydrogel was synthesized by oxidizing sodium alginate, to form a novel bio-crosslinker containing aldehyde groups, that can crosslink with silk fibroin, via Schiff base reaction, forming stable oxidized sodium alginate - silk fibroin (OSA-SF) hydrogel. FTIR analysis confirmed imine bond formation and SEM analysis demonstrated a good porous structure. Physical and in vitro characterization of crosslinked OSA-SF hydrogels showed that OSA-SF 3 hydrogel, with 7% (w/v) OSA and 5% (w/v) silk fibroin, exhibited efficient swelling, increased porosity, enhanced crosslinking index and increased biocompatibility of 20%, 5.3%, 89.24%, and 95%, respectively. Indomethacin (IDM) was encapsulated within the OSA-SF 3 hydrogel and conjugated with cyclic RGD (cRGD) peptide which is crucial for targeted integrin receptor binding on cells to enhance the anti-inflammatory and regenerative properties. Three formulations-IDM-cRGD 1 (1 mg/ml), IDM-cRGD 2 (2 mg/ml), and IDM-cRGD 3 (3 mg/ml)-were prepared and characterized. The indomethacin loaded hydrogels were observed as amorphous through X-ray diffraction studies, and the FTIR analysis depicted the presence of key functional groups of IDM-cRGD hydrogel at 1521–1527 cm^{-1} and 1232–1235 cm^{-1} respectively. The drug-loaded hydrogels showed 87% encapsulation efficiency. In vitro assessment using L929 fibroblast cells treated with drug loaded hydrogels exhibited over 95% cell viability. These results highlight the multifunctional potential of the IDM loaded hydrogel conjugated with cRGD for targeted wound healing applications.

Keywords: Hydrogel, Indomethacin, CRGD, Drug delivery, Wound healing.

ICEMSET-2026/FS/INV/256

From Dilution Refrigeration to Quantum Processing: Establishing Capabilities in Superconducting Qubit Technology

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Abstract

The invited talk will include the following points: (i) Scientific and technological importance of qubits, with particular emphasis on superconducting qubits and the role of dilution refrigeration in quantum processors; (ii)

Materials, design and fabrication challenges associated with superconducting qubits; (iii) Current capabilities and developments in superconducting-qubit fabrication and quantum hardware in India and worldwide; (iv) The pathway towards indigenous superconducting qubits and quantum processors, including the challenges of achieving system-level integration and technological self-reliance; (v) Establishment of the Quantum Hub at MAHE (Q-HUB@MAHE), MIT Bengaluru, as a university-led initiative to develop quantum-hardware expertise, strengthen research infrastructure, promote student skill development, and create an open-architecture ecosystem aligned with the objectives of India's National Quantum Mission.

ICEMSET-2026/FS/INV/257

Advances in Supercapacitor Technology: Materials, Mechanisms and Strategies for Enhanced Energy Storage

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Abstract

The growing demand for efficient, sustainable, and high-power energy storage technologies has stimulated significant interest in supercapacitors as complementary systems to conventional batteries. Supercapacitors offer rapid charge-discharge capability, high power density, excellent rate performance, and long cycle life, making them attractive for applications ranging from portable electronics and electric transportation to renewable energy integration. However, achieving simultaneously high energy density, power capability, and long-term stability remains a major challenge. This talk provides an overview of recent advances in supercapacitor technology, with particular emphasis on electrode-material engineering and the relationship between material properties and electrochemical performance. The talk will discuss the role of transition-metal oxides, nanostructured materials, composites, and doped metal oxides in improving charge-storage behavior. Particular attention will be given to copper oxide-based electrode materials and how elemental doping affects their structural, morphological, and electrochemical characteristics. Finally, the talk will address current challenges and future opportunities in supercapacitor research and the development of high-performance devices for next-generation energy storage applications.

Keywords: Material, Structural, Morphology, Supercapacitor.

ICEMSET-2026/FS/INV/258

Microwave-hydrothermally synthesized Ru-substituted $NiCo_2O_4$ spinel oxide nanoparticles for high-performance pseudocapacitor electrodes

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Abstract

Ru-substituted $NiCo_2O_4$ spinel oxide nanoparticles ($Ru_xNiCo_{2-x}O_4$, x = 0.00–0.10) were synthesized using a rapid, energy-efficient microwave hydrothermal method for high-performance supercapacitor electrodes. The effects of Ru substitution on structural, morphological, and electrochemical properties were systematically investigated. X-ray diffraction confirmed a single-phase cubic spinel structure (Fd-3m), while electron microscopy revealed uniformly distributed nanoparticles with mixed spherical and elongated morphologies and grain sizes of 32–55 nm. FTIR confirmed characteristic metal–oxygen bonding, and XPS revealed multiple oxidation states of Ni, Co, and Ru. Ru incorporation significantly enhanced pseudocapacitive performance. Among the compositions, $Ru_{0.06}NiCo_{1.94}O_4$ exhibited the best performance, delivering a specific capacitance of 1541 F g^{-1} and an energy density of 53.35 Wh kg^{-1} at a power density of 2233 W kg^{-1}. Dunn analysis, EIS, and Randles fitting indicated improved charge-transfer kinetics and reduced internal resistance. The enhanced performance is attributed to synergistic Ru substitution, nanoscale morphology, and microwave-assisted synthesis, facilitating ion diffusion and electron transport.

Keywords: Ru-substituted $NiCo_2O_4$; Microwave hydrothermal synthesis; Spinel oxide; Supercapacitors; Pseudocapacitance.

ICEMSET-2026/FS/INV/259

Organic Materials for Emerging Applications: Design, Synthesis, Characterization and Device Fabrication

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Abstract

Organic materials are becoming more popular because of their increasing applications. Organic materials are light weight (low density) compared to inorganic materials, less expensive, easy to make them, easy to get them in pure form, versatile & have high structural diversity. One can modulate the organic material properties like UV-Vis-NIR absorption, luminescence, solubility, thermal properties (T_m, T_d & T_g), and electrochemical properties using various substituents/ groups/ appendages. Further organic materials can be layered by adopting techniques like spin coating or thermal vacuum evaporation. Initially we worked on a "highly polarized excited state" hypothesis and informed that optically excitation of an organic molecule experiences charge polarization in the excited state. The polarization in the excited state has pivotal role in many applications of organic molecules as materials. *We at Indian Institute of Chemical Technology initiated research on these organic materials having various applications.* We have designed, synthesized, characterized various organic materials and further taken to fabricate the devices with collaborations to evaluate these organic materials towards their suitability for the proposed applications. We have made organic materials having applications in (i) Photoresists;[1,2,3] (ii) Molecular Switches;[4,5] (iii) Non Linear Optics (NLO);[6,7,8,9] (iv) Organic Light Emitting Devices (OLEDs)[10,11,12,13,14,15]; (v) Solar Cells,[16,17,18,19,20]; (vi) Two Photon Absorbing Materials; (vii) Forensic Applications; (viii) Ion Sensors; (ix) Delayed Fluorescence; and (x) Near Infrared Absorbing Materials The results obtained on these aspects will be discussed.

ICEMSET-2026/FS/INV/260

Intelligent MEMS Sensor Fusion with Edge AI for Early Detection and Prediction of Acute Myocardial Infarction

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Abstract

Acute Myocardial Infarction (AMI) remains one of the leading causes of mortality worldwide, with clinical outcomes critically dependent on the speed and accuracy of early diagnosis. Conventional diagnostic pathways, reliant on hospital-based electrocardiography (ECG) and biomarker assays, often introduce delays that compromise the "golden hour" for intervention. This study proposes an intelligent, wearable health-monitoring framework that integrates Micro-Electro-Mechanical Systems (MEMS) sensor fusion with Edge Artificial Intelligence (Edge AI) to enable continuous, real-time, and non-invasive detection and prediction of AMI risk. The proposed system employs a multi-modal MEMS sensor array—comprising accelerometers, gyroscopes, piezoresistive pressure sensors, and micro-acoustic transducers—to capture seismocardiographic, ballistocardiographic, and phonocardiographic signals reflecting mechanical cardiac activity. These heterogeneous data streams are fused using an adaptive Kalman-filter-based algorithm to suppress motion artifacts and enhance signal-to-noise ratio, followed by classification through a lightweight CNN-LSTM hybrid model deployed on an edge-computing microcontroller for on-device inference. Experimental validation was performed on synchronized MEMS and reference 12-lead ECG datasets collected from both healthy subjects and pre-infarction cardiac patients. The proposed fusion model achieved a classification accuracy of 96.4%,

sensitivity of 95.8%, and specificity of 97.1% in distinguishing pre-infarction mechanical cardiac signatures from normal variations, outperforming single-sensor baseline models by an average margin of 8–12%. The system demonstrated an average prediction lead time of 18–25 minutes prior to critical ST-segment elevation events, offering a clinically meaningful window for intervention. On-device inference latency averaged 42 ms per classification cycle, while total power consumption remained below 15 mW, confirming suitability for prolonged wearable operation. These results validate that MEMS-Edge AI integration can reliably shift AMI monitoring from reactive hospital diagnosis toward proactive, continuous, patient-centric surveillance, establishing a scalable and privacy-preserving foundation for next-generation smart cardiac wearables in remote and preventive cardiology applications.

Keywords: MEMS Sensors; Edge AI; Sensor Fusion; Acute Myocardial Infarction; Wearable Health Monitoring; Predictive Diagnostics; Seismocardiography.

ICEMSET-2026/FS/INV/261

Edge-Based Intelligent Sensing and Adaptive Control for Autonomous Smart Systems

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Abstract

The rapid expansion of Internet of Things (IoT) environments has resulted in an increasing need for intelligent systems that can operate autonomously and efficiently handle dynamic, heterogeneous and resource-constrained environments. This paper presents a framework for an intelligent edge-enabled smart system integrating multimodal sensing, real-time data processing, machine learning, and adaptive decision-making. The proposed framework collects the data from the distributed sensors and leverages an edge-based intelligence layer to analyze the contextual information with reduced latency and communication overhead. A novel adaptive decision mechanism is proposed to dynamically select sensing, processing and communication strategies according to the current environment conditions, system requirements and the available energy resources. The framework is intended for applications including smart healthcare, intelligent transportation, industrial automation and smart environments. The performance evaluation will be based on the accuracy, response time, energy consumption, scalability and system reliability. The goal of the proposed approach is to design an efficient and adaptive architecture for next generation autonomous smart systems.

Keywords: Smart Systems; Edge Intelligence; Internet of Things (IoT); Multimodal Sensing; Adaptive Decision-Making; Machine Learning; Context-Aware Computing; Autonomous Systems; Energy-Efficient Computing; Cyber-Physical Systems.

ICEMSET-2026/FS/INV/262

Spark Plasma Sintered SiC - 10% Al_2O_3 Composites: Microstructure and Mechanical Properties for High Temperature Electronic Device Applications

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Abstract

Silicon carbide (SiC) is a wide-bandgap (~3.26 eV) semiconductor whose high thermal conductivity (~3.7–4.9 W/cm- K) and elevated maximum junction temperature (>175–200 °C) enable high-power, high-temperature electronic devices, where substrate performance depends on density, grain structure, and secondary phases established during consolidation. This study investigates SiC-based composites containing 10 wt% alumina (Al_2O_3), processed from mixed powders into dense pellets by spark plasma sintering (SPS) at 1800 and 2000 °C for 5 min under 50 MPa. Sintered specimens were characterized by Archimedes density, Vickers hardness, indentation fracture toughness, X-ray diffraction (XRD), and scanning electron microscopy (SEM). XRD confirms SiC alongside Al_2O_3-related phases, indicating liquid-phase-assisted densification without complete reaction under short-dwell SPS. Vickers hardness and fracture toughness reflect competing effects of pore elimination and grain coarsening. Processing microstructure property correlations show SiC–10% Al_2O_3

composites sintered by SPS achieve balanced density, hardness, and toughness for thermally demanding electronic substrates, providing guidelines for optimizing SPS parameters to engineer robust, thermally conductive SiC-based ceramics for next-generation semiconductor devices.

Keywords: Silicon carbide, Spark Plasma Sintering, Alumina, High energy ball milling, fracture toughness.

ICEMSET-2026/FS/INV/263

Microscopic Theories of Cryogenic Emission of Electrons and Super-ionic Conductivity

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Abstract

In this talk, we briefly report our microscopic theories of: (i) cryogenic emission of electrons and (ii) super-ionic conductivity. While the former is important from the point of fundamental physics which helps in understanding the strongly correlated motions of electrons and electronic properties of several materials at low temperatures, the latter provides the basics of super-ionic conductivity and the foundations of the physics of a binary mixture of simple fluids. It also answers several important questions such as why the critical temperature of a real gas of lighter isotope of a given atom has lower value than that of the heavier isotope. etc. These theories not only agree closely with experiments as an ultimate proof of their accuracy but also have several merits like unparalleled simplicity of their mathematical formulation and clarity of scientific concepts and logic.

Keywords: Microscopic theories; Cryogenic emission of electrons; Electronic materials; Super-ionic conductivity; Energy materials.

ICEMSET-2026/FS/INV/264

Two-Dimensional Layered Nanomaterials: Emerging Materials for Next-Generation Energy Storage and Efficient Photocatalysis

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Abstract

The growing demand for sustainable energy and environmental remediation technologies has accelerated research into advanced functional nanomaterials. Two-dimensional layered nanomaterials have emerged as promising candidates because of their large specific surface area, tunable electronic structure, abundant active sites, and unique physicochemical properties. This work reviews the recent progress of major two-dimensional layered materials, including graphene-based materials, transition metal dichalcogenides, layered metal oxides, and MXenes, with particular emphasis on their potential in energy storage and photocatalysis. The influence of structural engineering, surface modification, defect generation, and heterostructure formation on charge transport, ion diffusion, and catalytic activity is critically discussed. These materials offer significant advantages for high-performance supercapacitors, rechargeable batteries, and photocatalytic systems by facilitating rapid charge transfer and improving the accessibility of electrochemically and catalytically active sites. Despite remarkable progress, challenges related to large-scale synthesis, structural stability, restacking, and long-term performance remain. Future developments in interface engineering and multifunctional hybrid architectures are expected to further enhance their practical applicability. Overall, two-dimensional layered nanomaterials represent a versatile platform for developing efficient next-generation energy storage and photocatalytic applications.

Keywords: Two-dimensional nanomaterials; Layered nanomaterials, Transition metal dichalcogenides, Graphene; Energy storage, Photocatalysis.

ICEMSET-2026/FS/INV/265

Charge Transport and Photoresponse in Semiconductor Junctions: Understanding the Role of Interfaces in Optoelectronic Devices

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Abstract

In semiconductor devices, interfaces are often the regions where critical electrical processes occur. Carrier injection, barrier formation, separation of photogenerated carriers, and their subsequent collection are strongly influenced by the nature of the junction. This talk examines these phenomena through selected studies of semiconductor junctions and nanostructure-based photodetectors. The presentation discusses devices including Schottky-type devices based on ZnS and ZnO/ZnS-related architectures, with emphasis on current–voltage characteristics, barrier-controlled transport, and light-induced electrical response. The discussion further extends to investigations of reduced graphene oxide (rGO) based photodetectors, specifically rGO integrated with metal oxides and sulfides such as ZnO and CuS, highlighting the influence of rGO incorporation on the electrical and photoresponse characteristics of the material. Selected experimental observations are used to connect junction physics, carrier dynamics, and measurable device performance, with particular relevance to UV photodetection and emerging nanoelectronic and optoelectronic applications.

Keywords: Semiconductor junctions; Schottky devices; charge transport; photodetectors; ZnO; ZnS; CuS; rGO; photoresponse.

ICEMSET-2026/FS/INV/266

Simulation of magnetic microbead detection by a planar Hall effect based magnetic field sensor optimized for biosensor applications

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Abstract

We simulate the M-H curve, AC susceptibility and static and dynamic planar Hall resistivity of a planar Hall effect based magnetic field sensor configured as a magnetic microbead detector to be used for biosensor applications. The sensor material is Permalloy (NiFe). Changes to the above curves are simulated in the presence of different types of magnetic microbeads including (i) Dynabeads M-280 (superparamagnetic) (ii) SiO_2 coated Fe_3O_4 nanoparticles (iii) Polystyrene coated Fe_3O_4 ferromagnetic microparticles. M-H curves are calculated using 3 micromagnetic packages (i) finite difference packages OOMMF (cpu) and μMAX (gpu) (ii) finite element package NMAG. The differences in the outputs of these packages are studied with in the light of the fact that curved surfaces, in this context the magnetic microbeads, are represented differently in finite difference and finite element methods of discretization. From the M-H curves, anisotropic magnetoresistance and planar Hall effect are calculated using the COMSOL finite element package. The high susceptibility regions, to be used for sensing application, are identified and the effects of choice of microbead material on the planar Hall resistivity is studied.

Keywords: Planar Hall effect, Magnetic microbead detection, Biosensor, Micromagnetic simulation, OOMMF, NMAG, μMAX.

ICEMSET-2026/FS/INV/267

AI-Driven Network Optimization for 6G: A Survey of Intelligent Resource Management, Distributed Learning, and Autonomous Control

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Abstract

Sixth-generation (6G) wireless networks are being developed toward architectures that more closely integrate communication, sensing, computing, and artificial intelligence (AI). This survey critically reviews AI-driven approaches to 6G network optimization, covering deep learning, deep reinforcement learning, federated learning, graph neural networks, digital twins, and explainable AI. The review considers radio resource allocation, energy efficiency, mobility management, network slicing, edge intelligence, and integrated sensing and communication. The literature indicates that these AI paradigms provide complementary capabilities for prediction, distributed learning, topology-aware optimization, and adaptive control, while their practical use remains constrained by generalization, latency, security, interoperability, and computational energy costs. The survey identifies hybrid, distributed, energy-aware, and trustworthy AI as important research directions for scalable optimization in future 6G networks.

Keywords: 6G; Artificial Intelligence; Network Optimization; Deep Reinforcement Learning; Federated Learning.

ICEMSET-2026/FS/INV/268

Heat Transfer using TPMS Lattice Structures

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Abstract

High heat flux in compact electronic devices increases the device temperature and reduces system performance. This work reports the fabrication of complex-designed TPMS metal lattice structures with Hybrid Manufacturing. The polymer lattices patterns are AM fabricated and further used to create ceramic mold which are used to cast AA6061 metal cellular lattice structures. The Shrinkage and density variations are observed using µCT images. The thermal Hydraulic Performance of different lattice configurations: Schwarz Primitive (SP), Schwarz Diamond (SD), Gyroid (G), and Kelvin Base (KB) as well as their concaving graded variants, are tested in an in-house fabricated air flowmeter under laminar flow conditions using air as the cooling medium. The study highlights that using concave gradation in designed lattice structures can substantially improve thermal management efficiency. Our design reduces temperature from 50°C to near room temperature without use of any external cooling device, making these designs promising for compact air-cooled electronic applications.

Keywords: TPMS; Additive Manufacturing, µCT.

ICEMSET-2026/FS/INV/269

Solid Lubricants for Sustainable and High-Performance Tribological Applications

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Abstract

Solid lubricants are alternatives to liquid lubricants for tribological systems operating under extreme loads, temperatures, vacuum, or contamination-sensitive conditions. This review critically examines advances in solid lubrication, focusing on lubrication mechanisms, material design, tribological performance, sustainability, and industrial applications. Layered materials such as MoS_2, graphene, and hexagonal boron nitride, together with carbon-based, polymeric, metallic, ceramic, nanostructured, and hybrid systems, are discussed. Key mechanisms including interlayer shear, transfer-film formation, tribofilm development, and tribochemical reactions are correlated with friction, wear, load-bearing capacity, temperature stability, and durability. Particular attention is given to two-dimensional materials, nanocomposites, and adaptive lubrication systems. Sustainability aspects including toxicity, resource utilization, recyclability, waste-derived materials, and life-cycle impacts are assessed. Applications in aerospace, space systems, electric vehicles, manufacturing, electronics, and energy

systems are reviewed. Challenges related to oxidation, adhesion, scalability, cost, durability, testing, and standardization are identified, with future directions involving computational design, multifunctional systems, sustainable feedstocks, and life-cycle assessment.

Keywords: Solid lubricants; Tribology; Two-dimensional materials; Nanocomposites; Sustainable lubrication.

ICEMSET-2026/FS/INV/270

Hydro-Engineered Smart Pavements: Advanced Permeable Materials and Sensor-Embedded Substructures for Climate-Resilient Infrastructure

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Abstract

This paper presents a sustainable materials paradigm shift through "Sponge City" road design, replacing conventional impervious surfaces with advanced permeable materials and multi-tiered subsurface architectures. Utilizing porous surface layers with a 15–25% void ratio alongside open-graded aggregate reservoirs, this hydro-engineered system facilitates rapid stormwater infiltration, suspended sediment filtration, and groundwater aquifer recharge. Emerging monitoring technology—including embedded void ratio sensors—is integrated within the stone matrices to deliver real-time volumetric storage and hydraulic attenuation data. Despite a 20% to 30% higher initial construction expenditure, long-term lifecycle analysis demonstrates significant net savings over 20 to 25 years by mitigating the need for traditional concrete drainage networks. Coupled with preventive maintenance technologies like regenerative-air vacuuming, these advanced materials provide a scalable, sensor-driven solution for flood-resilient urban infrastructure

Keywords: Permeable Pavements, Porous Asphalt, Open-Graded Aggregates, Geotextile Fabric, Pervious Concrete.

ICEMSET-2026/FS/INV/271

Wearable Sensors for Low-Power Engineering Applications

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Abstract

Wearable sensors are rapidly evolving in many applications as key enabler for continuous monitoring of low-power engineering systems, particularly for Internet of Things and healthcare applications. This work presents an overview of flexible electromagnetic solutions that support energy-efficient, and body-conformal wearable platforms. In the first part, we discuss the design of flexible dual-band antenna solution to provide reliable wireless connectivity across two communication bands while maintaining acceptable matching, radiation efficiency, and user comfort under bending and deformation scenarios. The second part examines flexible electromagnetic absorbers that are developed to suppress unwanted radiation, reduce interference, and enable recharging of low-energy sensors. Particular attention is given to lightweight substrates, conductive textiles, printable materials, and low-cost fabrication methods suitable for wearable integration. The combined use of flexible antennas and absorbers can enhance communication, energy efficiency, and sensing performance. These technologies offer promising solutions for remote health monitoring, biomedical telemetry, and distributed low-power IoT sensor networks.

Keywords: Antennas, flexible sensor, electromagnetic absorber, internet of things.

ICEMSET-2026/FS/INV/272

Efficiency of Deconvolution Neural Network for Image Classification Problem

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Abstract

Spatial and inter-channel correlation are frequently present in images, and can lead to redundant information in the representations learnt by conventional convolutional layers of CNNs. It may make the training of the network more complicated. This paper examines the effectiveness of a Deconvolution Neural Network for image classification to eliminate the redundant pixel-wise and channel-wise correlations in the input feature representations. It generates a decorrelated and sparse representation before the next operation. It differs from the conventional normalization-based methods by allowing the incorporation into the architectures of deep neural networks without relying solely on batch normalization to obtain good learned representations. The deconvolution-based approach's computational properties and classification performance are explored on various datasets of image classification and different neural network configurations. Experimental results show that deconvolution of the correlations between the networks can lead to better classification effectiveness, convergence behavior, better representation and computational efficiency.

Keywords: Deconvolution Neural Network; Image Classification; Convolutional Neural Network; Redundancy Reduction; Deep Learning.

ICEMSET-2026/FS/INV/273

DFT-Guided Design of Functional Nanomaterials and Quantum Dots for Efficient Hydrogen Storage

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Abstract

Hydrogen storage remains a major challenge for the development of sustainable energy technologies, stimulating the search for lightweight materials with high storage capacity and reversible adsorption. In this work, density functional theory (DFT) calculations are employed to explore the potential of functional nanomaterials and quantum dots as hydrogen-storage platforms. Particular attention is devoted to boron–nitrogen nanostructures, quantum dots, low-dimensional materials, and metal-functionalized systems involving Li, Na, Ti, and other metal centers. Structural stability, hydrogen adsorption energies, electronic properties, charge transfer, and adsorption mechanisms are systematically investigated. The calculations demonstrate that appropriate metal decoration can substantially enhance H_2 binding through polarization, charge redistribution, and metal–hydrogen interactions while preserving the structural integrity of the host material. These findings highlight DFT-guided materials design as a powerful strategy for identifying promising nanoscale materials for reversible and efficient hydrogen storage.

Keywords: Density Functional Theory; Quantum Dots; Hydrogen Storage; Nanomaterials; Metal Decoration.

ICEMSET-2026/FS/INV/274

Non-Invasive Photoplethysmographic Estimation of Heart Rate, HRV, and Hemoglobin Concentration

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Abstract

Photoplethysmography (PPG) provides a non-invasive approach for cardiovascular and biomarker monitoring, transitioning from contact-based sensors (t-PPG) to smartphone-based imaging (i-PPG). This study evaluated t-PPG (MAX30102 sensor) and finger-video i-PPG against standard clinical references for estimating heart rate

(HR), heart rate variability (HRV), and total hemoglobin (Hb). Data were collected from healthy volunteers under controlled conditions and pre-processed to remove baseline drift and noise. For HR estimation (N=20$), t-PPG achieved strong correlations with reference devices (r = 0.87–0.94), while i-PPG demonstrated comparable performance (r = 0.79–0.86). HRV analysis revealed elevated ln(RMSSD) ranges (3.433–5.77), warranting further investigation into participant health or lifestyle factors. For Hb estimation (N=21), optical attenuation features and demographics were evaluated using multiple machine learning models. XGBoost outperformed all models, achieving R^2 values of 0.9862 (t-PPG) and 0.9812 (i-PPG) with RMSEs of 0.0489 g/dL and 0.0329 g/dL, respectively, confirming i-PPG as a viable non-contact monitoring tool

Keywords: Photoplethysmography; non-invasive, iPPG, CVD, Hemoglobin, Machine learning.

ICEMSET-2026/FS/INV/275

Next-Generation Materials and Intelligent Manufacturing for Advanced Defense Applications

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Abstract

The rapid evolution of defense systems demands advanced materials and manufacturing technologies capable of delivering high strength, lightweight structures, enhanced durability, and superior performance under extreme operating conditions. This talk explores emerging materials and intelligent manufacturing approaches that are shaping the next generation of defense technologies. Particular emphasis will be placed on advanced metallic materials, high-performance alloys, multimaterial systems, and their integration with innovative fabrication processes. The presentation will discuss advanced welding, additive manufacturing, directed energy deposition, wire arc additive manufacturing (WAAM), and robotic manufacturing as enabling technologies for producing complex, large-scale, and high-performance components. The potential of multimaterial deposition, functionally graded structures, and advanced joining techniques for improving component performance and reducing manufacturing time and material waste will also be highlighted. Furthermore, the talk will examine the integration of artificial intelligence, machine learning, sensing, digitalization, and real-time process monitoring to develop intelligent and adaptive manufacturing systems. Applications in lightweight structures, repair and remanufacturing, high-temperature components, and mission-critical defense systems will be discussed. Finally, future research opportunities and challenges in developing reliable, scalable, sustainable, and digitally enabled manufacturing solutions for advanced defense applications will be presented.

Keywords: Welding, Defense, Additive Manufacturing, WAAM, Remanufacturing, Materials.

ICEMSET-2026/FS/INV/276

Green Functional Materials for Heavy-Metal Remediation: From Polymer Complexation to Sustainable Water Technologies

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Abstract

Heavy-metal contamination of water remains a persistent environmental challenge because of the toxicity, mobility and long-term persistence of metal ions such as cadmium and lead. This study examines the potential of green functional materials, particularly water-soluble polymers, polymer–metal complexes and low-cost sorbent materials, for the removal and stabilization of heavy metals from contaminated water. The work focuses on the interaction of functional groups in polymeric materials with metal ions and their role in improving metal binding, separation and remediation efficiency. Previous investigations involving poly(ethylene imine), polymer-assisted separation and environmentally compatible mineral and sorbent materials demonstrate the potential of functional materials for effective heavy-metal capture and immobilization. The study further

considers how these approaches can support scalable and sustainable water-treatment technologies. It concludes that appropriately designed functional materials can provide an effective bridge between polymer chemistry, environmental remediation and green water-treatment strategies, with future opportunities for developing reusable, selective and resource-efficient materials.

Keywords: Green Functional Materials; Heavy-Metal Remediation; Polymer Complexation; Water Treatment; Sustainable Technologies.

ICEMSET-2026/FS/INV/277

AI and Machine Learning for Next-Generation Sensors, MEMS, and Smart Systems

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Abstract

The integration of Artificial Intelligence (AI) and Machine Learning (ML) with sensors, Micro-Electro-Mechanical Systems (MEMS), and smart technologies is transforming conventional sensing into intelligent, adaptive, and autonomous systems. This talk explores recent advances in AI/ML-enabled sensing technologies and their role in developing next-generation smart systems. Emphasis will be placed on intelligent data processing, sensor fusion, anomaly detection, predictive analytics, and real-time decision-making using machine learning and deep learning approaches. The presentation will highlight how MEMS-based sensors can be combined with edge AI, Internet of Things (IoT), and intelligent computing platforms to enable low-power, reliable, and autonomous applications. Examples from healthcare, robotics, industrial monitoring, autonomous systems, and smart infrastructure will be discussed. The talk will also address key challenges, including data quality, model reliability, computational constraints, cybersecurity, and real-time deployment. Finally, future research opportunities toward self-aware and intelligent sensing systems will be presented.

Keywords: Sensors, MEMS, IoT, Machine learning, AI.

ICEMSET-2026/FS/INV/278

Electrical Impedance Based Health Monitoring of Biological and Non-Biological Materials: A Journey from Macro to Micro

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Abstract

Biological tissues are developed with the three-dimensional array of the biological cells suspended in an extracellular matrix. The intracellular fluids like cytoplasm and nucleus-fluids are also found to be conducting in nature. The cell membranes of animal and plant cells are developed with protein-lipid-protein bi-layer which produces a capacitive reactance towards the alternating electrical excitation. Collectively the biological tissue provides a complex electrical impedance towards the AC current flow through it which is called bioelectrical impedance or bioimpedance. Bioimpedance of the biological tissues depends on the tissue structure, tissue composition and the tissue health. The biological tissue health and composition can be assessed by measuring the electrical impedance of the tissue sample. In this direction, to study the tissue physiology and anatomy from the electrical impedance measurement, a number of methods have been proposed such as bioelectrical impedance analysis (BIA), electrical impedance plethysmography (IPG), electrical impedance cardiography (ICG), electrical impedance myography (IMG), electrical impedance spectroscopy (EIS), electrical impedance tomography (EIT). Electrical impedance spectroscopy (EIS) has been found to be a promising technique not only in the biomedical applications, but also in other areas of applications for different material characterization. BIA, IPG and ICG are applied for medical applications. EIS is found as a non-destructive testing technique which measures the electrical impedance of the material under test and provides the information about the material composition, structure and health. Due to its several advantages the EIS technology has been applied to test, analyse and characterize the materials in a number of research areas such as electrical engineering,

mechanical engineering, civil engineering, metallurgical engineering, material engineering, chemical engineering, biomedical engineering, food technology, biotechnology, microbiology and other applied sciences. In the EIS based material testing process, an array of surface electrodes is attached to the material under test and the electrical impedance and phase angle of the material is measured at several frequencies. To measure the electrical impedance of the materials is estimated by applying a constant amplitude of alternating current (or voltage) signal and measuring the voltage (or current) signal developed. A low frequency, constant amplitude electrical AC current (or voltage) signal is applied at a number of frequencies (f: f_1, f_2, f_3, … f_n) and the developed AC voltage (or current) signal is measured at all the frequencies. The electrical impedance (Z: Z_1, Z_2, Z_3, … Z_n) and the phase angles (θ: θ_1, θ_2, θ_3, … θ_n) are calculated at all the frequency points. The imaginary parts of the impedance (Xz: Xz_1, Xz_2, Xz_3, … Xz_n) are plotted over the real part of the impedance (Rz: Rz_1, Rz_2, Rz_3, … Rz_n) and the Nyquist plot is obtained to obtain the equivalent electrical circuit of the material. Electrical impedance tomography (EIT) is a CT imaging modality which uses electrical signals instead of X-Rays. Thus, EIT is found basically as a nonionizing CT scanning procedure which has been applied in a number of research domains to solve several practical problems. Conventional CT imaging techniques such as X-Ray CT, PET, SPECT, MRI have been found with different advantages and limitations and and therefore, these modalities are found with their potential to be used in different applications. But due to some unique advantages, EIT has proved itself as a promising CT-modality in the field of medical, biomedical and non-medical applications. EIT is found with a wide range of applications in several research domains. EIS is an electrical impedance-based material characterization technique which collects the lumped impedance (Z, θ) parameters over a particular frequency range (f: f_1, f_2, f_3, … f_n). On the other hand, EIT is an radiation-free electrical signal-based CT technique (works without applying X-Rays) that provides the spatial distribution of electrical conductivity or resistivity of the domain under test. EIS and EIT both are found very fast, safe, portable, low-cost, and hence it has been applied in biomedical engg., mechanical engg., chemical engg., civil engg., material engg., biotechnology, and many other fields of engineering and applied sciences. In this talk, the speaker will discuss the fundamentals of the electrical impedance methods such as BIA, IPG, ICG, IMG, EIS and EIT technologies and followed by the discussion on the instrumentation design and development. The impedance measurement techniques, the effect of the geometry, material and other properties of the lelectrical impedance sensors (surface electrodes) will be discussed. The author will also highlight the basics of contact impedance problems in impedance measurement systems and the remedies will be summarized. Different application of EIS and EIT will be discussed in detail highlighting the present scenario, recent research trends and technology associated challenges. The research trends on EIS and EIT technologies in micro and nano technology will also be discussed. The advantages, limitations, future possibilities of EIS and EIT testing will be summarised.

Keywords: Computed tomography (CT), bioelectrical impedance, electrical bioimpedance, electrical impedance spectroscopy (EIS), electrical impedance tomography (EIT), electrical impedance measurement, micro-systems, nanotechnology.

ICEMSET-2026/FS/INV/279

Multi-Physics Simulation of Nano-Filled Thermal Interface Materials (TIMs) for High-Power EV Electronics

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Abstract

A thorough multiphysics analysis framework is presented here to analyze thermal performance, transient and structural reliability of multilayer power module on application of EV. Thermal transient FEA coupled with linear-elastic structural stress analysis is explored for the heat dissipation phenomena and mechanical drivers of failure across the entire packaging stack (Silicon Carbide SiC dies, DBC Substrate, polymer TIM, and Aluminum baseplate). The work also studies the exact influence of filler volume fraction (from 20% to 60%) on the effective thermal conductivity and peak junction temperatures (Tj, from 318 C down to 208C). Besides, the work coupled with Coffin-Manson fatigue life estimation and von Mises stress value (1.210 9Pa) to map localized cyclic wear-out regions and thermal interface degradation. The result offers a key insight to balance thermal performance and mechanical integrity of the next generation power electronics packaging.

Keywords: Finite Element Analysis, Junction Temperature, Multiphysics Modeling, Silicon Carbide, Thermal Conductivity, Thermal Interface Material, Thermo-Mechanical Stress, von Mises Stress.

ICEMSET-2026/FS/INV/280

From Molecular Recognition to Smart Detection- Advanced Sensors for Emerging Contaminants in Environmental Monitoring

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Abstract

Emerging contaminants (ECs) are widely acknowledged as serious threats to the environment and public health. Sensitive, selective, rapid and consistent monitoring technologies are required due to their existence, diversity, persistence and trace concentrations. A possible complimentary approach for rapid and potentially on-site detection of ECs is demonstrated by advanced environmental sensors. The paper examines how materials science, chemistry and physical transduction mechanisms are integrated as it moves from molecular recognition to quantifiable sensor response. Interactions between target contaminants and sensing interfaces such as hydrogen bonding, electrostatic interactions, π-π interactions, adsorption and selective receptor-based recognition will be discussed. The role of advanced sensing materials: metal organic frameworks, nanomaterials, metal oxides, graphene-based materials and molecularly imprinted materials will be reviewed. With an emphasis on selectivity, sensitivity, reaction time, detection limits and performance in complicated environmental matrices, electrochemical and optical sensing technologies will be investigated through selective examples. One significant aspect for real time environmental surveillance will be the shift from laboratory-based sensing devices to miniature, portable and intelligent monitoring platforms.

ICEMSET-2026/FS/INV/281

Emerging AI Technologies in Digital Pathology: Interpretable Computational Imaging for Cancer Biomarker Discovery

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Abstract

Digital pathology provides an opportunity to transform routinely acquired histopathology images into quantitative data for cancer research. This work investigates interpretable computational image analysis approaches for characterizing tissue architecture and identifying image-derived features associated with clinically relevant outcomes. Quantitative analysis of hematoxylin and eosin-stained tissue images was used to characterize tumor and stromal morphology, with particular emphasis on collagen architectural organization within the tumor microenvironment. Computational features describing patterns such as collagen fragmentation, rigidity, density, bundling, and anisotropy were evaluated using statistical and machine-learning approaches across independent cancer cohorts. The analyses demonstrated that quantitative tissue-architectural features capture biologically and clinically relevant information and that selected collagen-derived features are associated with patient outcomes and molecular characteristics in head and neck and colorectal cancers. These findings highlight the potential of interpretable computational pathology to extract additional information from routinely available histology images. Such approaches may complement conventional pathological assessment and support the development of reproducible, explainable imaging biomarkers for precision oncology.

Keywords: Digital pathology; Computational pathology; Artificial intelligence; Tissue architecture; Cancer biomarkers; Precision oncology.

ICEMSET-2026/FS/INV/282

A High-Gain Stacked Rectangular Dielectric Resonator Antenna with Defective Ground Structure for C-Band Applications

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Abstract

A Stacked Rectangular Dielectric Resonator Antenna (SRDRA) incorporating a pentagonal-shaped Defective Ground Structure (DGS) and a U-shaped microstrip feed is proposed for C-band applications. The proposed configuration employs sequential excitation, wherein the lower resonator is aperture-coupled and subsequently excites the upper resonators through electromagnetic coupling. The resonators are fabricated using alumina with a relative permittivity of 9.8 and a loss tangent of 0.002, while the substrate dimensions are 46 × 46 × 1.6 mm³. The antenna operates over 6.0–6.9 GHz and is excited through a 50-Ω microstrip line. The simulations performed using Ansys HFSS demonstrate a minimum return loss of −45 dB and a peak gain of 7.9 dB at the resonant frequency of 6.2 GHz. An impedance bandwidth of 13.95% and a broad 3-dB beamwidth of approximately 125° are obtained. The proposed antenna is suitable for C-band microwave links, satellite communication, and defence applications.

Keywords: Dielectric Resonator Antenna (DRA), Stacked RDRA, Defective Ground Structure (DGS), Aperture Coupling, Microstrip Feed, C-band.

ICEMSET-2026/FS/INV/283

Memory in Motion: Fractional-Order Derivatives and the Modeling of Non-Markovian Dynamics in Electronic Systems

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Abstract

Most physical and engineering systems are conventionally modeled using integer-order differential equations, which implicitly assume Markovian dynamics — where the future state depends only on the present, with no memory of the past. However, many electronic and material systems are inherently non-Markovian, exhibiting hereditary, history-dependent behavior. Fractional-order derivatives, particularly the Caputo and Riemann–Liouville operators, provide a powerful mathematical framework to capture this "memory" effect through their non-local, weighted-history kernel structure. This talk explores the memory-encoding power of fractional calculus and its relevance to memory-dependent phenomena in electronic materials and devices, such as dispersive charge transport in disordered semiconductors and memristive systems, where carrier and state dynamics depend on their entire conduction history rather than instantaneous conditions alone. Concrete mathematical formulations are illustrated through fractional-order memory-dependent models, demonstrating how such operators bridge abstract mathematical memory with observable, history-dependent behavior in real physical systems.

Keywords: Fractional calculus, Caputo derivative, Riemann–Liouville derivative, memory effect, non-Markovian dynamics, dispersive charge transport, memristive systems.

ICEMSET-2026/FS/INV/284

Structural, Electronic and Thermoelectric Properties of CrSSe and CrSeTe Janus Monolayers

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Abstract

In the present manuscript, the density functional theory-based simulation is used for investigating the structural and electronic properties of Janus monolayers CrSSe and CrSeTe. The electronic bandgap of 0.85 eV for CrSSe and 0.62 for CrSeTe has been obtained. The values of Seebeck coefficient and lattice thermal conductivity for (n-type) p-types Janus monolayers CrSSe and CrSeTe are (1340) 1390 μVK^{-1} , (971) 1010 μVK^{-1}, and 11.01 W/K and 0.25 W/K respectively. The value of ZT for (n-type) p-types Janus monolayers CrSSe and CrSeTe are (0.92) 0.93 and (0.95) 0.96, respectively, at room temperature. The thermoelectric performance of these monolayers is higher as compared to homogeneous $CrSe_2$ monolayer due to their unique structural and

compositional characteristics. These results contribute valuable insights into designing and optimizing Janus monolayers for advanced thermoelectric applications, and pave the way for promising advancements in sustainable energy harvesting.

Keywords: Density Functional Theory, Boltzmann Transport Equation, ZT, Thermoelectric Properties.

ICEMSET-2026/FS/INV/285

Robotic Surgery in Children- Precision in action

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Abstract

A surgical procedure in a child is a challenge as the space involved is limited and the tissues require gentle handling. This calls for great care and optimal skill to deliver the best possible outcome for the ailing child. For a surgeon in the current age, recent advance in the form of Robotic Technology is available. Robotic Surgery is a combination of Artificial Intelligence, Simulation and Mixed Reality supporting a surgical procedure being carried out precisely. The Robotic arm surpasses the human counterpart in the ability to move with greater degree of freedom and accuracy inside the human body, as directed by the human surgeon. Mixed Reality provides a magnified and 3-dimensional view of the operating field aiding gentle handling of tissues and accurate placement of sutures. Thus, a surgical procedure in a small child can be undertaken successfully, which also assists in the early recovery of the child.

Keywords: Artificial Intelligence, Simulation, Mixed Reality, Robotics, Emerging Technology.

ICEMSET-2026/FS/INV/286

Investigation of structural properties and anti-bacterial activity of bio-synthesized Fe:Ag nanocomposites

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Abstract

This study reports the synthesis of Fe:Ag composite nanoparticles by green approach by utilizing the *Urtica dioica* leaves extract, as reducing and capping agent for the synthesis of required nanoparticles. The synthesized composite phases found to depend on the salt sources used, which provides different ion species in the reaction mixture. The formation of crystalline nanoparticles possessing cubic structure was confirmed by XRD analysis. Ag rich crystalline nanoparticles were found to disperse in the oxidized Fe matrix by high resolution transmission microscopic studies. XPS analysis revealed the presence of Fe of in 0, +2, and +3 valance states and Ag in Ag+1 and Ag^{o} states. The bio-synthesized nanoparticles were found to show notable antibacterial activity against the gram-negative pathogen E. Coli and gram-positive pathogen S. aureus.

ICEMSET-2026/FS/INV/288

Next-generation nanomedicines for visceral leishmaniasis: Artemisinin-based nanocarriers and gold nanoparticles for enhanced parasite clearance and host immunity

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Abstract

Visceral leishmaniasis (VL), caused by the *Leishmania donovani* complex, remains a life-threatening neglected tropical disease, with treatment challenged by toxicity, emerging drug resistance, prolonged therapy, HIV co-

infection, spread to non-endemic zones, relapse in the form of PKDL and the absence of an effective vaccine. The intracellular localization of parasites within macrophages further limits conventional drug delivery. This presentation highlights our nanomedicine approaches using artemisinin-loaded PLGA nanoparticles (ALPLGA), nanoliposomal artemisinin (NLA) and gold nanoparticles (GNPs). ALPLGA and NLA markedly reduced hepatic and splenic parasite burden in experimental VL by up to 85% and 82%, respectively, while enhancing Th1-biased immunity, lymphocyte proliferation and protective IgG2a responses. GNPs also showed potent activity against extracellular and intracellular *L. donovani*. Collectively, these findings demonstrate the potential of nanotechnology to combine enhanced parasite clearance with restoration of host protective immunity, offering promising avenues for safer and more effective VL therapy.

Keywords: Nanomedicine; Nanoliposome; Artemisinin; Visceral leishmaniasis; Gold nanoparticles.

ICEMSET-2026/FS/INV/289

The Power of BigData Analytics

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Abstract

The Power of Big Data Analytics lecturer can cover the big data analytics characteristics of the big data types of analytics, challenges of big data, big data analytics VS traditional data analytics, NOSQL databases and data exploration, Big data analytics tools and technology for big data analytics, big data analytics real time project ideas and Applications.

Keywords: Big data analytics, NOSQL.

ICEMSET-2026/FS/INV/290

Incorporation of RGO Nanosheets into Ni-doped Co_3O_4 Nanocomposites for Memristor Applications

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Abstract

Simple and inexpensive hydrothermal techniques were used to prepare the samples of rGO-based Ni-doped Co_3O_4 nanocomposites. The current work illustrates the innovative synthesis of porous nanosheets built by quantum dots for use in memristors using hydrothermal approaches. We employed I-V characteristics (Keithaly milliampere 2400) with the current and voltage sweep for the memristor application. The rGO-based 5% Ni-doped cobalt oxide nanosheets exhibit a higher memristor performance. The current effort developed a novel, unique 2D morphology that is ideally suited for use in a memristor. From FESEM, it was clearly observed that the nanosheets are made from the quantum spheres, which is helpful to increase the performance of the material.

ICEMSET-2026/FS/INV/291

Importance on Thin Film Technology and Nanomaterial Characterization Techniques

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Abstract

Over the last 100 years, there has been an increase in the process of depositing thin film materials, which has been considerably developing. A good understanding of the various deposition methods and processes is necessary to improve the desired film thickness and characteristics. The purpose of this article is to display the critical analysis of existing thin film deposition methods. This paper highlights some important thin film techniques that are advanced and suitable for the analysis of thin films. Nanomaterials are invisible and require various advanced characterization to investigate their physical and chemical properties.

Keywords: Thin Film Technology, Nanomaterial, deposition methods, and Characterization Techniques.

ICEMSET-2026/FS/INV/292

A Novel Optimized Design of Energy Efficient Lights for Producing Uniform Illumination by Harnessing Photoluminescent Properties of 'Strontium Aluminate'

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Abstract

Electrical energy consumed worldwide today amounts to about 22,500 terawatt-hour (TWh). A larger chunk of this electrical energy is used to produce light energy. Excessive production of light energy (termed as 'light pollution') causes a disturbance in the natural environment that living beings live in. The very light energy when produced above a threshold poses certain drawbacks such as disrupting ecosystems, in particular affecting nocturnal wildlife, adverse health effects such as sleep disorders, increased headaches, etc. Hence, there seems to be a stronger need for developing a substitute for electrical form energy used for producing light energy. The research proposal discloses a portable lighting device that harnesses the properties of photo luminescent pigment 'Strontium Aluminate' for producing light energy by utilizing a free source of energy. The lighting device uses a portion of 'Strontium aluminate' mixed with freely available 'water' resource to produce light energy in the presence of black light.

Keywords: Photoluminescent Properties; Strontium Aluminate; Black Light; Energy Efficient Lighting; Portable Lighting Device; Light Pollution.

ICEMSET-2026/FS/INV/293

AI Models, Data Centres and Water Resources: Balancing Innovation with Environmental Responsibility

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Abstract

Rule-based systems, machine learning, deep learning, and generative foundation models are examples of artificial intelligence (AI) that is revolutionizing public services, industry, healthcare, education, and scientific research. Productivity, prediction, accessibility, and decision-making can all be enhanced by these apps. However, data centers with energy-intensive processors that produce a lot of heat are necessary for training and running sophisticated AI models. While the production of power and semiconductors generates additional indirect and embodied water footprints, cooling these facilities may directly use freshwater. Particularly in hot or water-stressed areas, rapid data center construction may put more strain on aquifers, rivers, crops, homes, and aquatic ecosystems. Innovation in science, better services, and chances to maximize water and cooling management are all positive results. Resource competition, ecological deterioration, uneven community burdens, and inadequate transparency are examples of negative effects. Therefore, effective models, water-aware siting, closed-loop cooling, treated wastewater, transparent reporting, independent auditing, and intentional use by people and organizations are all necessary for sustainable AI.

Keywords: AI models; Meta centres; Sustainable AI; Water footprints.

ICEMSET-2026/FS/INV/294

Search Efficiency in the Quantum Era: A Grover's Algorithm Study

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Abstract

Searching for a target element in large datasets is a core operation across computing, from database retrieval to cryptography. As data volumes grow, efficient search algorithms become increasingly vital to system performance. Classical search algorithms applied to unsorted data rely on sequential, exhaustive examination of elements. Without any structural assumptions, a classical algorithm must inspect up to N items to guarantee finding the target, resulting in O(N) time complexity. This study examines Grover's algorithm, a quantum search technique designed to overcome the limitations of classical search. The algorithm leverages the principles of superposition and amplitude amplification. An iterative oracle-and-diffusion process amplifies the probability amplitude of the correct solution while suppressing incorrect ones. This mechanism enables identification of a target element in approximately O(√N) queries, compared to the O(N) requirement of classical methods. Overall, this work highlights the practical value of quantum computing and points to the need for further research, including the development of quantum-resistant encryption.

Keywords: Grover's search; Quantum gates; Time complexity; Oracle; Hadamard Gate; Diffusion operator.

ICEMSET-2026/FS/INV/295

Electronic, Magnetic and Optical Properties of $Al_{1-x}Cr_xP$

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Abstract

The theoretical calculations of structural, electronic and magnetic and optical properties of $Al_{1-x}Cr_xP$ (x=0.125) Diluted Magnetic Semiconductor (DMS) in Zinc Blende phase(B3) has been performed using Density Functional Theory (DFT) as implemented in the Spanish Initiative for Electronic Simulations with Thousands of Atoms (SIESTA) code with LDA+U exchange-correlation (XC) potential. The study of spin polarized electronic band structures and magnetic properties represents induction of half metallic ferromagnetic behaviour in $Al_{0.875}Cr_{0.125}P$ with 100% spin polarization. The hybridization of Cr-3d states with s and p states of Al and P develops some local magnetic moment on non-magnetic and P atoms. The calculated results of different properties are compared with available literature data and are in good agreement.

Keywords*:* Aluminium Phosphide; DFT; SIESTA; Half metallic compounds; Ferromagnetism.

ICEMSET-2026/FS/INV/296

An Automated Deep Learning Framework for Renal Tumor Detection and Analysis Using CT Images

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Abstract

Renal tumors are abnormal masses that develop within the kidney, and their early detection is essential for accurate diagnosis and effective treatment planning. Computed Tomography (CT) imaging is widely used for visualizing renal anatomy and identifying suspicious abnormalities. However, manual interpretation of CT images is time-consuming and may be affected by inter-observer variability. To address these challenges, this study proposes an automated deep learning-based pipeline for renal tumor detection and analysis using CT

images. The proposed framework consists of four major stages: preprocessing, kidney-region segmentation, feature extraction, and tumor classification. During preprocessing, noise reduction and contrast enhancement are performed to improve image quality. Kidney-region segmentation is then used to isolate the kidney from surrounding anatomical structures, followed by feature extraction to identify relevant image characteristics. A Convolutional Neural Network (CNN) is subsequently employed to classify CT images into normal and tumor-affected categories. The performance of the proposed framework is evaluated using image-quality metrics, including Mean Squared Error (MSE), Peak Signal-to-Noise Ratio (PSNR), and Signal-to-Noise Ratio (SNR), along with classification metrics such as accuracy, precision, sensitivity (recall), and F1-score. These results indicate that the proposed approach provides effective and consistent performance for automated renal tumor classification from CT images. The system has the potential to assist radiologists by reducing analysis time and supporting more consistent CT-based assessment of renal abnormalities.

Keywords: Renal Tumor, Neural Networks, Deep Learning, CNN, CT images.

ICEMSET-2026/FS/INV/297

Nanocomposite Polymer Electrolytes for Fuel Cell Application

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Abstract

In the recent years, due to the depletion of non-renewable fossil fuel reserves, demand for alternative energy sources has gained growing attention. Among the alternative power supplies, fuel cell technology thanks to its environmentally friendly nature and high efficiency. The relatively high cost of Nafion membranes is limited and the development of alternative proton-conducting materials is required. Nanocomposite polymer electrolyte based on PVA was prepared using solution casting technique. FTIR shows confirms the interaction of proton from the salt with electropositive atoms in PVA. AC impedance spectroscopy confirms the highest ionic conductivity of 10^{-5} Scm^{-1} is obtained for the highly amouphous polymer electrolyte (crystallinity 68% as confirmed from DSC analysis) and proves it to be best suited for fuel cell application.

Keywords: Fuel cell, Proton polymer electrolyte, Nanocomposite, FTIR, Impedance, XRD.

ICEMSET-2026/FS/INV/298

Functionalized Nanoparticle Bioconjugates for Bioimaging, Anticancer and Antibacterial Application

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Abstract

Nanobiotechnology provides multifaceted solutions from cancer to antibacterial therapeutics. Conventional therapy, chemotherapy has several drawbacks. Nanoparticles-based drug delivery systems have shown promise in addressing these drawbacks. In this direction, we designed synthesis of various drug delivery systems including various nanoparticles such as gold nanoparticles, silver nanoparticles, quantum dots, carbon dots. With this, cell-penetrating and targeting peptide-based nanoparticles with anticancer drug, doxorubicin has attracted a huge interest because of their applicability in targeted drug delivery. Carbon dots and quantum dots were used for bioimaging of cells. The biocompatibility of synthesized nanoconjugates was analysed against L929 normal cells and anticancer activity against HeLa cells. The nanoconjugates exhibited good

biocompatibility and efficient anticancer activity against cancerous cells. Simultaneously, the public's health is at serious risk due to growing threat of antimicrobial-resistant diseases. In response, we developed innovative nanomaterial-based biocompatible antibacterial agents derived from silver nanoparticles and biomolecules, showed high antibacterial against gram-positive and gram-negative bacteria.

Keywords: Nanoparticles, Multi drug resistance, Cancer, Bioiamging, Peptides.

ICEMSET-2026/FS/INV/299

Statistical Model of Electron Conduction through Metal and Semiconductor Junctions and in Superconductors

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Abstract

A model based on statistical thermodynamics that was proposed by Rice to describe the electronic polarization at the metal surface, which is based on the hypothesis that the electrochemical potential of the electron throughout the metal is constant, is completed by taking the photoelectric effect into account. This model describes quite satisfactorily the Peltier effect as well as the electric capacities of the inner layer at metal-electrolyte interfaces. Its generalization to the PN junction of semiconductors allows us to explain how the electric current flowing across the junction varies as function of the applied potential and temperature. Statistical thermodynamics can also explain the transition between the superconducting and resistive states in superconductors by assuming the existence of thermodynamic equilibrium between a bosonic phase containing Cooper pairs and a fermionic phase of free electrons.

Keywords: metal polarization, Peltier effect, semiconductors, PN junction, superconduction.

ICEMSET-2026/FS/INV/300

Material Characterization and Non-Local Thermal Wave Dynamics in Nanostructures

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Abstract

Classical thermoelasticity governed by Fourier’s law fails at the nanoscale due to its assumption of instantaneous heat propagation, while standard integer-order delay models frequently exhibit severe mathematical instabilities. To overcome these limitations, this study presents a unified non-local thermal transport framework that integrates the Caputo time fractional derivative with two-temperature dual-phase-lag thermodynamics. The Caputo fractional operator serves as a crucial non-local memory operator, pulling continuous historical thermal state data to capture hereditary thermal properties inherent in microstructural phonon-electron interactions. By tuning the fractional order across its spectrum, the model smoothly interpolates between localized heat conduction, fractional thermoelasticity, classical parabolic transport, and undamped hyperbolic wave propagation, revealing that lower fractional orders significantly enhance energy dissipation and suppress thermal wave peaks. Combined with Chen & Gurtin's two-temperature theory, the system transforms into the Laplace domain and is solved via closed-form Mittag-Leffler functions, guaranteeing mathematical well-posedness, solution uniqueness, and asymptotic stability. The physical capability of the framework is demonstrated through the material characterization of a thin Nickel nanowire. This generalized model provides an accurate, mathematically stable foundation for characterizing and engineering heat dissipation in advanced nanomaterials, including nanowires, thin films, carbon nanotubes, and graphene.

Keywords: Caputo Fractional Derivative; Dual-Phase-Lag Model; Nanoscale Thermal Transport; Material Characterization; Two-Temperature Theory.

ICEMSET-2026/FS/INV/301

Modification in Physical Properties of $CoFe_2O_4$ and Al Substituted Nanoparticles due to Sintering at Different Temperatures

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Abstract

In this work a systematic study has been carried out for the $CoFe_2O_4$ and $CoAlFeO_4$ nanoparticles by means of x-ray diffractometer, Transmission electron microscope, Vibrating sample magnetometer and Mössbauer spectrometer. Sol gel auto combustion method was employed to synthesize the studied compounds. A significant reduction in the lattice parameter and crystallite size has been observed. After Al doping in $CoFe_2O_4$ nanoparticles the crystallite size of doped and undoped samples become similar (~45 nm) at 1100 ^oC of sintering. The obtained results from TEM measurements are in good agreement with the x-ray diffraction results. Furthermore, the obtained cationic distribution from the Mössbauer spectra is in consistent with the Rietveld refined data. A significant increase in saturation magnetization was observed as the sintering temperature increases from 300 to 1100 ^oC in both the series of samples. In $CoFe_2O_4$ samples a large decrement in coercivity and remanent magnetization was observed, while in $CoAlFeO_4$ samples reduction in coercivity and increment in remanent magnetization was observed with same sintering temperatures. Mössbauer spectra confirmed the coexistence of superparamagnetic and ferrimagnetic behavior in the $CoAlFeO_4$ nanoparticles at room temperature, which is absent in the $CoFe_2O_4$ nanoparticles.

Keywords: nano particles, ferrites, super-paramagnetism, hysteresis, ferrimagnetism, coercivity.

ICEMSET-2026/FS/INV/302

Exploring the Optical Limiting Behavior of Nickel Molybdate in the Nanoregime

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Abstract

The deployment of high-intensity laser systems necessitates robust optical limiting mechanisms governed by nonlinear optical phenomena. The growing use of high-intensity laser technologies and the consequent demand for efficient optical limiters have brought nonlinear optical materials into sharp focus. Among the various candidates explored, transition metal molybdates have emerged as promising materials owing to their strong optical absorption, tunable band gaps, and notable luminescent characteristics. In this work, nickel molybdate ($NiMoO_4$) nanostructures were synthesized via a simple chemical precipitation method for potential nonlinear optical applications. The structural conformation of the synthesized nanostructures was confirmed through X-ray diffraction (XRD) analysis, which revealed characteristic diffraction peaks corresponding to the monoclinic phase of $NiMoO_4$, consistent with standard reference data. Scanning electron microscopy (SEM) images revealed an agglomerated, nanoflake-like morphology with a rough surface texture, indicative of the nanocrystalline nature of the sample. Elemental composition and purity were verified using energy-dispersive X-ray spectroscopy (EDX), confirming the presence of nickel, molybdenum, and oxygen in the expected stoichiometric ratio. The optical absorption behavior, examined via UV–visible spectroscopy, showed a distinct absorption edge, from which the optical band gap was estimated using Tauc plot analysis. The nonlinear optical properties of the $NiMoO_4$ nanostructures were evaluated using the Z-scan technique under pulsed laser excitation, revealing pronounced reverse saturable absorption behavior attributed to two-photon absorption (2PA), with a negative nonlinear absorption coefficient characteristic of an efficient optical limiter. The nonlinear refractive index and third-order nonlinear susceptibility ($\chi^{(3)}$) were also determined, further substantiating the material's strong, fast (electronic) nonlinear optical response. These findings suggest that $NiMoO_4$ nanostructures hold significant promise as effective optical limiting materials for applications in laser safety devices and photonic technologies.

ICEMSET-2026/FS/INV/306

Sustainable Onion Peel-Derived Copper Nanoparticles for Dual-Function Wastewater Bacterial Detection and Methyl Orange Degradation

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Abstract

Wastewater from industrial and domestic sources is often contaminated with pathogenic bacteria and organic pollutants, posing significant risks to human and environmental health. This study investigated the green synthesis of copper nanoparticles (CuNPs) using *Allium cepa* L. (onion) peel extract (OPE) as a natural reducing and stabilising agent. CuNPs were synthesised using a sand-bath-assisted method, with pH, temperature, and reaction time optimised for nanoparticle stability. UV–Vis, FT-IR, HRTEM, DLS, and XRD analyses confirmed the formation of spherical, crystalline OPE-CuNPs ranging from approximately 3–21 nm. The nanoparticles exhibited strong antibacterial activity against *Klebsiella pneumoniae*, achieving MIC and MBC values of 12.5 µg/mL. Inhibition zones of 12.5 ± 0.3 and 25.5 ± 0.3 mm were obtained at 50 and 100 µg/mL, respectively. Additionally, OPE-CuNPs achieved 96% methyl orange degradation under sunlight within 25 min. These findings demonstrate the potential of onion-peel-derived CuNPs for sustainable wastewater remediation and biowaste valorisation.

Keywords: Green synthesis, Copper nanoparticles (CuNPs), Onion peel extract, Antibacterial activity, Methyl orange degradation.

ICEMSET-2026/FS/INV/307

Hybrid Residual-Attention Network for Cyber-Attack Detection in Smart Grid Communications

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Abstract

Smart grid communication networks are increasingly exposed to cyber-attacks that can disrupt monitoring, compromise control decisions, and reduce system reliability. Detecting these attacks accurately and quickly is difficult because normal traffic often contains noise, temporal variation, and class imbalance. This paper proposes a hybrid residual-attention network for cyber-attack detection in smart-grid communications. The method combines residual anomaly scoring with temporal sequence encoding and an attention mechanism to emphasize the most informative time steps in network traffic. Compared with conventional machine-learning baselines and recurrent models, the proposed framework is designed to improve precision, recall, and F1-score while keeping the architecture compact enough for practical deployment. The paper builds on the residual-based smart-grid anomaly detection direction introduced by Yu et al. and extends it with a temporal attention layer for stronger attack discrimination.

Keywords: Smart grid, cyber-attack detection, anomaly detection, residual learning, attention mechanism, intrusion detection, time-series classification.

ICEMSET-2026/FS/INV/308

Effect of Complexing Agent Concentration on Structural and Optical Properties of CTS Thin Films

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Abstract

This study investigates the role of complexing agent, Na2EDTA concentration in enhancing the structural and optical properties of Copper Tin Sulfide (CTS) thin films deposited via the SILAR method. Varying Na2EDTA concentrations (0.01M, 0.04M, 0.07 M) results in improved structural and optical properties. The films exhibit crystalline structure with crystallite sizes 51.2 to 84.1 nm and dislocation densities between 1.4×10^{14} and 3.81×10^{14} m $^{-2}$. Transmittance curves show low transmittance in UV region and high transmittance in the visible region. The samples are highly absorptive in the UV range and become more transparent in the visible range, showing applications in optical filtering and photovoltaic devices. Tauc plots estimate high band gap energies indicates that it can be used as buffer layers in solar cells. The correlation between band gap energy and crystallite size as a function of Na2EDTA concentration is also observed. The findings highlight the potential of CTS thin films for applications in solar cells, optical filtering, and photonic devices.

Keywords: CTS thin-film; SILAR; Crystal Quality; Complexing Agent; Band Gap Energy.

ICEMSET-2026/FS/INV/309

Can We Triple the Power Output from the Same Solar PV Foot Print?

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Abstract

Baseline efficiencies of solar panels are: Monocrystalline Silicon 19-23%; polycrystalline:15-18%; Thin-film:10-3%. High-Efficiency Premium Modules (TOPCon, HJT): 21%–24% efficiency Modern solar PV panels reflect only 2%-8% of the sunlight. The temperature can rise to as much as 35-41°C with 500W/m^2 solar flux. This degrades the baseline efficiency(E) by 4-7%. With 750W/m^2 solar flux the efficiency degrades by 6-9%. In this paper we describe, how using a patented core technology we can convert the rest of the solar energy to AC electrical power with additional 2 times E with zero water consumption and reduced degradation effect of solar heat. The power can then be easily phase matched with the solar PV AC output. Thus, with the same solar PV footprint we can generate 3X power with 33% cost reduction per MWh. We also discuss how a simple and low-cost technology can store the generated power without any battery for later use.

Keywords: Baseline efficiency; Tripling the solar output; Zero water consumption; Energy storage without battery; Efficiency degradation.

ICEMSET-2026/FS/INV/313

Application of FIA-TLS technique for monitoring the photocatalytic activity of BFO based semiconductors

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Abstract

A flow injection thermal lens spectrometric detection method is developed for parallel dual-channel monitoring of hexavalent chromium reduction and trivalent chromium formation during photocatalytical process under natural solar irradiation using pure and Pr-Co co-doped bismuth ferrite (Bi(1-x)PrxFe(1-x)CoxO3, x=0.00-0.10) semiconductors. Cr(VI) was quantified selectively through colorimetric reaction with 1,5-diphenylcarbazide (DPC), while Cr(III) was detected directly. Two complementary pump-probe beams configurations were

implemented within the same flow-through unit consisting of a 532 nm excitation/633 nm probe arrangement, related to absorption maximum of Cr-DPC complex, and a 647 nm excitation/543.5 nm probe beams arrangement attributed to the d-d transition of hexa-aqua Cr(III) complex. The 8% Pr–Co co-doped BFO sample provides the optimal photocatalytic properties, achieving over 80 % conversion of Cr(VI) to Cr(III) within 120 min, indicating FIA-TLS system as a successful platform for heavy-metal remediation in environmental samples.

Keywords: Wastewater Treatment, Photothermal Techniques, Thermal Lens Spectroscopy, Flow Injection Analysis, BFO Based Semiconductors.

ICEMSET-2026/FS/INV/315

Utilization of Municipal and Industrial Waste for Fuel Briquette Production: An RSM-CCD Optimization Study

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Abstract

Improper disposal of solid waste can contribute significantly to land, water and also air pollution in which including greenhouse gas emissions. This work explores the conversion of five non-conventional waste streams which are tailoring cloth waste, newspaper waste, fruit peel waste, Ashoka leaves waste, and then timber waste which into densified fuel briquettes using starch as a binding agent. Material characterization was performed through different analysis like FTIR, XRD, SEM and also TG/DTA alongside proximate and ultimate analysis. Briquette quality was assessed through a calorific value, porosity, shatter index, compressive strength, tumbling test and also water boiling test for thermodynamic efficiency. Optimization was carried out by using Response Surface Methodology (CCD) which is a computational design. Results were demonstrated that municipal and also an industrial waste can be effectively repurposed into a clean, low-cost solid fuel, supporting waste reduction and energy sustainability goals.

Keywords: Solid waste, fuel briquettes, densification, calorific value, thermodynamic efficiency, sustainable energy.

ICEMSET-2026/FS/INV/316

Valorization of Pod-Based Biomass Residues into Sustainable Solid Fuel Briquettes: A Response Surface Methodology (CCD) Optimization Approach

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Abstract

Rising fossil fuel is a dependence and also an improper disposal of agricultural residues which have an intensified the need for renewable solid fuels. This study investigates the fuel briquettes prepared from five pod-based biomass materials—Bauhinia variegata, Mesquite, peanut pods, survey pods, and Albizia lebbeck pods in which using starch as a binder. The materials were characterized using different analysis which are FTIR, XRD, SEM, and TG/DTA, followed by proximate and ultimate analysis. Briquette performance was evaluated through a calorific value, porosity, water absorption, shatter index, compressive strength, tumbling test, and also degree of densification. Response Surface Methodology (CCD) was computational optimization technique also applied

to optimize process parameters and then compared predicted versus experimental results of pods. Findings of these indicates pod-derived briquettes offer a viable and also a biodegradable alternative to charcoal and firewood for cooking and industrial heating applications.

Keywords: Pod biomass; fuel briquettes; starch binder; calorific value; Response Surface Methodology; waste-to-energy.

ICEMSET-2026/FS/INV/317

Electrochemical Charge Storage Behavior of $MnMoO_4$/Ni-MOF Composite Electrodes

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Abstract

The search for efficient electrode materials with high charge-storage capability is important for the development of advanced supercapacitors. In this work, a $MnMoO_4$/Ni-MOF composite was developed and investigated as an electrode material for supercapacitor applications. The combination of $MnMoO_4$ with Ni-MOF was intended to utilize the redox activity of $MnMoO_4$ along with the porous nature of the Ni-MOF framework, providing better access to electrolyte ions and electrochemically active sites. The synthesized composite was characterized using appropriate structural and morphological techniques to examine its phase formation and surface features. Its electrochemical behavior was evaluated through cyclic voltammetry, galvanostatic charge–discharge, and electrochemical impedance spectroscopy in an alkaline electrolyte. The $MnMoO_4$/Ni-MOF electrode showed distinct redox activity and achieved a high specific capacitance of 1200 F g^{-1}. This improved charge-storage performance is associated with the combined contribution of the $MnMoO_4$ and Ni-MOF components, which facilitates ion transport and charge-transfer processes within the electrode. The results suggest that the $MnMoO_4$/Ni-MOF composite can serve as a promising electrode material for high-performance supercapacitor applications.

Keywords: MOF (Metal-Organic Framework), Electrolyte, Supercapacitors.

ICEMSET-2026/FS/INV/318

First-Principles Study of Sulfur-Vacancy-Engineered ZrS_2 Monolayer for Selective Hazardous Gas Detection

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Abstract

Monitoring hazardous gases in semiconductor-related environments is essential for process safety. In this work, the sensing performance of pristine and sulfur-vacancy-engineered ZrS_2 monolayer towards NH_3, NO_2, SiH_4, and GeH_4 is investigated using DFT and NEGF calculations. Adsorption-site analysis was first performed to identify favourable gas adsorption configurations, followed by a comparison of single and double-sulfur vacancy structures, which showed formation energies of 5.378 and 10.072 eV, respectively, confirming the single vacancy as the energetically favourable configuration. Gas adsorption studies revealed weak interactions on pristine ZrS_2 (−0.05 to −0.34 eV), whereas sulfur-vacancy engineering enhanced the adsorption of NH_3 and NO_2. Among the studied gases, NO_2 exhibited the strongest interaction with ZrS_2–V_s, with an adsorption energy of −1.44 eV and enhanced charge transfer. Consequently, NEGF-based transport analysis showed an increased NO_2 sensitivity of 5.99% for ZrS_2–V_s, while the recovery time decreased to 0.06 s at 673 K. These results demonstrate the potential of sulfur-vacancy-engineered ZrS_2 for thermally reusable NO_2 sensing in semiconductor-related environments.

Keywords: Density functional theory, Gas sensing, Density of states, Projected density of states, Monolayer.

ICEMSET-2026/FS/INV/319

High-Aspect-Ratio SnO_2 Nanorods with Enhanced NO_2 Sensitivity: A Synergistic Study of Crystallinity, Surface Area, and Functional Groups

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Abstract

This work reports the hydrothermal synthesis and comprehensive characterization of SnO_2 nanorods for room-temperature gas sensing. XRD confirmed tetragonal rutile SnO_2 with (110) orientation, while FTIR revealed Sn-O vibrations and hydroxyl groups, indicating active surface chemistry. FESEM showed densely packed, high-aspect-ratio of diameter:length (1:45) nanorods, and BET analysis measured a surface area of 25.6 m^2/g. Gas sensing tests against NO_2, NH_3, SO_2, ethane, and CO demonstrated superior selectivity toward NO_2, with a 110.5% response, rapid dynamics (22.29 s/30.26 s), and a detection limit of 467 ppb. Enhanced performance is attributed to exposed (110) facets, hydroxylated surfaces, and elevated surface area.

Keywords: Physisorption, nanorods, n-type semiconductor, charge transfer.

ICEMSET-2026/FS/INV/320

Interfacial Engineering for Enhanced Thermoelectric Performance in 2D GaN/WSeTe van der Waals Heterostructures: A DFT–NEGF

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Abstract

Two-dimensional (2D) materials have emerged as promising candidates for thermoelectric applications because their interfacial interactions can be engineered to improve charge and energy transport. In this study, the structural, electronic, and thermoelectric transport properties of GaN/WSeTe van der Waals heterostructures (vdWHs) are systematically explored using density functional theory (DFT) in conjunction with the non-equilibrium Green's function (NEGF) approach. The atomic configurations of the heterostructures are first optimized to obtain stable interfacial structures, followed by an investigation of their electronic properties. Analysis of the band structure and projected density of states indicates the formation of a type-II band alignment, which can facilitate efficient charge-carrier separation and interlayer transport. Quantum transport calculations based on the NEGF formalism further reveal the influence of interlayer interactions and interface scattering on the thermoelectric response. The formation of the heterostructure leads to a pronounced enhancement in electrical conductance (Ge), which can be associated with improved interlayer coupling and suppressed carrier scattering at the interface. Conversely, the Seebeck coefficient exhibits a continuous reduction with increasing temperature, primarily due to thermal broadening of the electronic states and the associated reduction in energy-filtering efficiency. Notably, the dimensionless thermoelectric figure of merit (ZT) varies from 0.96 to 3.63 at at $\mu = \sim 0.64$, while values ranging from 0.89 to 2.36 are obtained at $\mu = \sim -2.6$ for the Se-4 and Te-3 configurations, respectively, across the temperature range of 300–900 K. The obtained results highlight the potential of GaN/WSeTe vdWHs for efficient thermoelectric energy conversion and provide a theoretical basis for designing advanced 2D heterostructures for next-generation energy technologies.

Keywords: DFT, 2D heterostructures, Thermoelectrics, figure of merit (ZT).

ICEMSET-2026/FS/INV/321

Design of Bi-MOF@$NiCo_2O_4$ Composite for Enhanced Electrochemical Performance of Supercapacitors

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Abstract

The development of efficient electrode materials is essential for improving the energy storage performance of supercapacitors. In this study, spinel $NiCo_2O_4$ was synthesized by a hydrothermal method using nickel and cobalt salts as precursor materials. A bismuth-based metal-organic framework (Bi-MOF) was subsequently integrated with $NiCo_2O_4$ to form a hybrid Bi-MOF@$NiCo_2O_4$ composite, followed by thermal treatment. The structural, morphological, and functional properties of the prepared materials were investigated using X-ray diffraction, scanning electron microscopy, transmission electron microscopy, and Fourier-transform infrared spectroscopy. The electrochemical performance was evaluated using cyclic voltammetry, galvanostatic charge-discharge, and electrochemical impedance spectroscopy. The Bi-MOF@$NiCo_2O_4$ composite demonstrated improved electrochemical characteristics compared with the individual components, with enhanced charge-storage behavior and stable cycling performance. The improved performance is attributed to the synergistic interaction between Bi-MOF and $NiCo_2O_4$, which facilitates redox reactions, ion transport, and charge transfer. The results indicate that Bi-MOF@$NiCo_2O_4$ is a promising electrode material for advanced supercapacitor applications.

ICEMSET-2026/FS/INV/322

A Review on Nanostructure Material Fabrication and Application in Drug Delivery

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Abstract

Nanomedicine has emerged as a promising field in healthcare due to its potential to develop innovative pharmaceutical formulations. Nanomaterials can enhance drug stability, bioavailability, efficiency, systemic half-life, and controlled drug release while reducing the required dose and associated side effects. Various nanostructures, including nanoliposomes, micelles, dendrimers, polymeric and inorganic nanoparticles for pharmaceutical applications. However, challenges such as precise drug-release control, biodistribution, toxicity, biodegradation, interactions with tissues, cells, organs, and biomolecules need to be addressed. Nanostructured-materials also have significant applications in semiconductor and medical fields. Among them, ZnO nanorods possess strong exciton binding energy and photon–exciton coupling properties, making them useful in optoelectronic applications such as lasers, LEDs, and detectors, as well as in medical applications photodynamic cancer therapy. In addition, tungsten oxide nanoparticles have been explored for the development of sensitive electrochemical sensors. Overall, nanostructured-materials offer considerable opportunities for developing effective, stable, targeted, patient-friendly pharmaceutical and biomedical applications.

ICEMSET-2026/FS/INV/323

Cooperative Physical Layer Security for Next Generation Networks

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Abstract

In communication networks, security is a very important factor; thus, the message from the sender to the receiver must be secure and not be eavesdropped on. The next generation wireless networks, 5th Generation & beyond, and IoT networks are to be secure, as these are the vehicles of transmission and reception. Traditionally, encryption methods and techniques have been used predominantly in communication networks; physical-layer security provides an alternative way to secure data. The randomness of wireless channels and media provides a

great opportunity to protect communication networks. My research explores cooperative wireless systems using a basic building block of a sender, receiver, and relays in the presence of an eavesdropper. The relay selection in cooperative networks can be made dependent on link quality, and a relay may not transmit if the eavesdropper is in the vicinity of the receiver with stronger links. The metrics Secrecy Capacity Outage and Secrecy Efficiency Outage are analyzed in depth, our system model is explored, and secrecy capacity and energy efficiency are established as the governing factors for intelligent relay selection. We also explored Reconfigurable Intelligent Surfaces (RIS), in which the number of reflecting elements is examined and optimized. This led to the concept of Adaptive RIS design and optimization, where we design a system in which, for the 2nd hop, that is from RIS to Receiver, the number of reflecting elements for RIS transmission is selected to maximize average secrecy capacity, satisfying an average power constraint. Then we explored another direction and derived a formula for a reliable PHY-secrecy range for RIS positioning and secure coverage. Through these analytical formulations and simulation results, the research has progressively moved from intelligent relay selection to optimized RIS design and predicting the hovering range of UAV for secure communication. The talk will discuss these contributions and shed light on how intelligent cooperative relaying, Adaptive RIS design, and RIS-mounted UAV hovering range enhance the secrecy of communication networks.

Keywords: Physical Layer Security; Reconfigurable Intelligent Surfaces; Unmanned Aerial Vehicle; Secrecy Capacity; Secrecy Efficiency.

ICEMSET-2026/FS/INV/325

Polysaccharides based Functional Polymers: Luminescence Characteristics

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Abstract

The traditional luminescent materials are frequently used in high tech areas of encryption, imaging and sensing applications. The presence of extended π conjugation systems interacting through bond conjugation in planar organic compounds is prerequisite for efficient luminescence performance. Their luminescence characteristics diminish in aggregated state usually refereed as aggregation induced quenching (AIQ). Further these conventional organic materials with high toxicity and complicated synthesis methodologies encourages us to explore biomacromolecules with clusteroluminescence. Many natural polymers including carbohydrates, polysaccharides and proteins display luminescent characteristics. These natural polymers are generally non-planar and non-conjugated compounds displaying blue luminescence and their mechanism of luminescence involves through space conjugation of many heteroatoms (N, O, S, P) via n…n, n…π and hydrogen bonding interactions causing extensive delocalization of electrons. They are called as clusteroluminogens due to aggregation induced emissions (AIE). The clustering of large number of heteroatoms and the abundant energy levels decreases the energy gap between singlet and triplet states so delayed luminescence is observed. These clusteroluminogens with electron rich functionalities inspire the future development of fluorophores based on natural precursors possessing merits of biocompatibility, low cytotoxicity and easy synthesis which can be useful in biosensing and bioimaging.

Keywords: Polysaccharides; Luminescence; Clusteroluminogens; Aggregation Induced Emission; Through Space Conjugation.

ICEMSET-2026/FS/INV/326

Surface Functionalization of Nanostructured Porous Carbon for Enhanced CO_2 Adsorption

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Abstract

The increasing concentration of carbon dioxide (CO_2) in the atmosphere has intensified the need for efficient and economically viable carbon capture technologies. Adsorption using porous carbon materials has emerged as a promising approach owing to their high specific surface area, tunable pore structure, low density, and

relatively low regeneration energy. However, the adsorption performance of pristine porous carbon is often limited by weak interactions between the carbon surface and CO_2 molecules. In this study, surface functionalization of nanostructured porous carbon is proposed to enhance its CO_2 adsorption capacity and selectivity. The approach involves tailoring the surface chemistry of porous carbon through the incorporation of oxygen- and nitrogen-containing functional groups while preserving the desirable hierarchical pore structure. Surface modification is expected to introduce additional basic and polar adsorption sites, thereby strengthening the interaction between CO_2 molecules and the carbon surface. The relationship between surface functional groups, pore characteristics, textural properties, and CO_2 adsorption behavior will be systematically investigated. Characterization techniques such as BET surface-area analysis, scanning electron microscopy, Fourier-transform infrared spectroscopy, and elemental analysis can be employed to establish structure–property relationships. CO_2 adsorption isotherms and regeneration studies will further evaluate adsorption capacity, selectivity, and cyclic stability. The proposed functionalized nanostructured porous carbon platform offers potential for developing efficient, reusable, and scalable adsorbents for post-combustion CO_2 capture and other carbon-management applications.

Keywords: Porous carbon; Surface functionalization; CO_2 adsorption; Nanostructured materials; Carbon capture.

ICEMSET-2026/FS/INV/327

Beyond Idealization: Capturing Antibody Geometry and Antibody–Antigen Binding in Nanowire Biosensing

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Abstract

This talk presents a rigorous investigation of sensing performance in a silicon junctionless nanowire biosensor, with particular emphasis on the consequences of realistic antibody geometry for sensitivity prediction. For the first time, the intrinsic shape, dimensions, and orientation of Y-shaped antibodies are explicitly incorporated into the numerical model with minimal geometric idealization, enabling a physically representative description of antibody–biomolecule interactions. Threshold-voltage and ON/OFF-current sensitivities are systematically evaluated for target biomolecules with distinct sizes and dielectric properties. The results reveal substantial departures from conventional idealized analyses, with threshold-voltage sensitivity deviations reaching approximately 93–180%. The study further establishes the influence of antibody orientation on multiplexed biomolecule detection, identifying side-on and lying-on configurations as particularly significant. These findings demonstrate that realistic antibody representation is essential for quantitatively reliable biosensor analysis and provide a more rigorous framework for evaluating nanoscale biosensor sensitivity without the overestimation associated with simplified ideal models.

Keywords: Antibody; Biomolecule; Biosnsor; Sensitivity; Realistic.

ICEMSET-2026/FS/INV/328

Exploiting Corner-Point Field Confinement in Germanium-Tin Tunnel FETs for Ultra-Sensitive S-Protein Screening and Analysis

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Abstract

This work introduces a $Ge_{1-x}Sn_x$ tunnel field-effect transistor (TFET) biosensor optimized for S-protein biomarker detection by strategically leveraging the corner-point effect at the source–channel junction. Validated against experimental data from a fabricated GeSn TFET, the simulation framework incorporates a nanogap cavity to assess biosensing efficacy. Systematic investigations into channel epilayer thickness and Sn mole fraction (x) evaluate critical metrics, including responsivity, sensitivity, stability, and linearity. Crucially, the analysis reveals a distinct trade-off, demonstrating that optimal electronic performance does not inherently yield

the maximum biosensing response. While a 10-nm epilayer thickness proves optimal, the ideal GeSn composition depends on specific target requirements. Consequently, a simplified structure omitting the vertical cavity is proposed at a representative mid-range composition ($x \approx 0.04$). Ultimately, this study yields an optimized $Ge_{0.958}Sn_{0.042}$ TFET biosensor featuring a hybrid low-k/high-k dielectric cavity, offering a high-performance pathway for biomolecular diagnostics.

Keywords: Biosensor, GeSn alloy, Responsivity, Sensitivity, TFET.

ICEMSET-2026/FS/INV/329

Structure–Property Relationships in Carbazole-Based Donor–Acceptor Luminogens for Solid-State Luminescence

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Abstract

The development of efficient organic luminophores with controllable emission properties is an important objective in contemporary materials chemistry. This presentation describes our research on the molecular design of carbazole- and triphenylamine-based donor–acceptor luminogens, with particular emphasis on understanding the relationship between molecular structure, electronic communication, and solid-state photophysical behavior. By systematically modifying the donor and acceptor units, π-conjugated spacers, molecular symmetry, and substitution patterns, we have developed luminophores exhibiting tunable solution- and solid-state emission across a broad spectral range. Particular attention is given to aggregation-induced emission, solid-state luminescence, solvatochromism, and mechanofluorochromism, demonstrating how molecular conformation, intramolecular charge transfer, and intermolecular packing influence the excited-state properties. The studies establish clear structure–property correlations and provide useful molecular design strategies for developing color-tunable and stimuli-responsive organic luminophores. These findings have potential relevance to the development of functional materials for optoelectronics, chemical sensing, information security, and advanced photonic applications.

ICEMSET-2026/FS/INV/330

AI-Driven Emerging Technologies and the Future of Intelligent Electronics

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Abstract

Artificial Intelligence (AI) is revolutionizing intelligent electronics by enabling smarter, faster, and more autonomous technological systems. The integration of AI with emerging technologies such as the Internet of Things (IoT), machine learning, semiconductor devices, robotics, and edge computing is transforming modern electronic applications. AI-driven systems facilitate real-time data processing, predictive analysis, intelligent automation, and energy-efficient operations. Advancements in smart sensors, adaptive circuits, neuromorphic computing, and intelligent communication networks are further expanding their capabilities. This abstract explores recent developments, potential applications, and future challenges of AI-driven intelligent electronics, highlighting their role in shaping sustainable, connected, and technologically advanced societies.

ICEMSET-2026/FS/INV/331

Synergistic Ni-MOF/bio-carbon dot hybrid electrode for selective and sensitive detection of metformin

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Abstract

The escalating discharge of pharmaceutical contaminants into environmental and clinical systems raises significant concerns regarding water quality and public health, thereby requiring the development of rapid, accurate, and sustainable detection techniques. This study successfully developed a biomass-derived Ni-MOF/BCQD hybrid electrode for the electrochemical detection of metformin. Carbon quantum dots (BCQDs) were synthesized from tapioca peel using a hydrothermal method and integrated with a nickel-based metal-organic framework to form a highly conductive and catalytically active sensing platform. Structural and surface analyses confirmed the successful formation of the hybrid composite. XRD and FTIR results verified the crystalline Ni-MOF framework and the presence of BCQD functional groups. XPS analysis revealed the existence of redox-active Ni^{2+} species. The morphology exhibited a porous and well-dispersed structure. BET analysis indicated an increase in surface area from 312 to 358 m^2 g^{-1} after hybridization. Electrochemical investigations demonstrated a clear concentration-dependent response toward metformin in the 10–150 µM range, with a distinct oxidation peak at approximately 0.50 V (vs. Ag/AgCl). The sensor demonstrated good sensitivity, excellent linearity (R^2 = 0.995), and a detection limit (LOD) of 1.12 µM, as well as appropriate repeatability (RSD < 5%) and stability (>94% retention after 15 days). The synergistic effect of Ni^{2+}/Ni^{3+} redox mediation and the conductive network provided by biomass-derived BCQDs are responsible for the improved sensing performance. This work presents a sustainable and effective approach for the development of electrochemical sensors for pharmaceutical monitoring.

Keywords: Ni-MOF., Bio derived carbon quantum dot, Hybrid electrode, Metformin sensor.

ICEMSET-2026/FS/INV/332

Solution Processed Functional Nanomaterials for Advanced Computing

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Abstract

For the past three decades, Nanotechnology has grown at an enormous rate and recent advances in nanostructured materials and nanodevices have opened up new opportunities in a variety of applications, ranging from information and communication technology to healthcare and medicine. The fabrication of modern electronic devices through solution processing enabled us to molecular-level control of material composition and structure that may lead to devices and fabrication strategies not possible with conventional top-down methods. Resistive random-access memories (RRAM) are promising alternatives to existing computer memories which may offer a potential leap beyond the limits of Flash memories (concerning write speed, write energies) and Dynamic random-access memories DRAM (concerning scalability, retention times). A conventional RRAM cell is composed of an insulating/dielectric layer sandwiched between two metallic layers. In this talk, I will highlight some novel ceria-based nanostructures fabricated using solution-processed methods for their applications as RRAMs. The overview of physical and electrochemical processes which may be the origin of the switching phenomenon in these materials will be discussed.

ICEMSET-2026/FS/INV/333

Ultra-Precision Polishing of Optical Materials

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Abstract

Ultra-precision polishing is important for making optical surfaces smooth and accurate. In this work, the polishing of optical materials is studied to obtain a high-quality surface with very low roughness and fewer

surface defects. The polishing process is carried out by controlling the abrasive material and other important process conditions. The effect of these conditions on material removal and surface quality is examined. Special attention is given to reducing surface damage and maintaining the required shape of the optical surface. The polished surfaces are evaluated by measuring surface roughness, waviness, and form accuracy using suitable measurement techniques. The study shows that careful control of the polishing process can improve the quality of optical surfaces. The proposed approach can be useful for manufacturing lenses, mirrors, windows, and other precision optical components used in imaging, laser, sensing, and scientific application.

Keywords: Optical Materials, Super polished surface, Surface Roughness.

ICEMSET-2026/FS/INV/334

Cardioprotective Effects of *Artemisia nilagirica* via Modulation of Insulin Signaling Pathways in Type 2 Diabetic Rats

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Abstract

Type 2 diabetes mellitus (T2DM) is characterized by insulin resistance and is associated with an increased risk of cardiovascular complications. Impaired cardiac insulin signaling and oxidative stress contribute substantially to myocardial metabolic dysfunction and structural injury. *Artemisia nilagirica*, a medicinal plant containing bioactive flavonoids and terpenoids, has demonstrated potential antidiabetic and cardioprotective properties. However, its effects on cardiac insulin signaling in T2DM remain insufficiently characterized. This study aimed to investigate the mechanistic effects of *A. nilagirica* on cardiac insulin signaling, oxidative stress, and myocardial structural changes in experimental T2DM. T2DM was induced in Wistar rats using a high-fat diet followed by streptozotocin administration. Animals were allocated into control, diabetic, and *A. nilagirica*-treated groups receiving different doses of the plant extract. Fasting blood glucose, insulin resistance indices, and oxidative stress biomarkers were assessed. Cardiac tissue was evaluated histopathologically, while expression of key components of the insulin signaling pathway, including insulin receptor substrate-1 (IRS-1), phosphoinositide 3-kinase (PI3K), protein kinase B (Akt), and glucose transporter 4 (GLUT4), was investigated using Western blotting and PCR. *A. nilagirica* treatment reduced fasting blood glucose and improved insulin sensitivity in diabetic rats. Treatment enhanced PI3K/Akt signaling and increased GLUT4 translocation in cardiac tissue, accompanied by attenuation of oxidative stress. Histopathological examination demonstrated reduced myocardial structural damage and fibrosis in treated animals compared with diabetic controls. *A. nilagirica* favorably modulates cardiac insulin signaling in experimental T2DM, potentially through enhancement of the PI3K/Akt/GLUT4 pathway and reduction of oxidative stress. These findings support further investigation of *A. nilagirica* as a potential adjunctive cardiometabolic therapeutic agent in diabetes.

Keywords: Artemisia nilagirica; Type 2 diabetes mellitus; Cardiac insulin signaling; PI3K/Akt/GLUT4 pathway; Oxidative stress; Cardioprotection.

ICEMSET-2026/FS/INV/335

Prussian Blue Analogues as Functional Nanomaterials for Sustainable Anodic Electrocatalysis

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Abstract

The transition toward sustainable energy technologies requires electrocatalytic systems capable of producing green hydrogen while simultaneously generating value-added chemicals with low energy consumption.

Replacing the sluggish oxygen evolution reaction (OER) with alternative anodic oxidation reactions (AORs) offers a promising strategy to reduce cell voltage and improve process economics. Prussian blue analogues (PBAs) nanomaterials, with their tunable composition, open framework, redox-active metal centers, and structural flexibility, provide an attractive platform for designing efficient electrocatalysts through metal-site modulation, defect engineering, ligand management, heterostructure construction, and electronic-structure tuning. This presentation discusses PBA-based nanomaterials as electrocatalysts for diverse anodic oxidation reactions, including alcohols, biomass-derived compounds, urea, hydrazine, ammonia, and iodide. Particular emphasis will be placed on dynamic surface reconstruction, coordination chemistry, defects, and interfaces, supported by operando spectroscopy to establish structure-activity relationships.

Keyword: Functional nanomaterials; Prussian blue analogues; anodic oxidation reaction; hydrogen production; electrochemical reconstruction.

ICEMSET-2026/FS/INV/336

Meniscus-controlled Dynamic Annular-gap Contactless Entirely Detached Long-length Sb-based Crystals growth in Vertical Directional Solidification (VDS) under 1g

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Abstract

Entirely detached, long-length crystallization of Sb-based materials under 1g is demonstrated in vertical directional solidification (VDS). Self-oriented nucleation at the conical ampoule apex evolves into a self-adjusting annular-gap geometry, where the meniscus and crystal–melt interface remain dynamically coupled with the crystal while contact with the ampoule wall is suppressed. The governing pressure field is constrained by the Young–Laplace relation, with evolving meniscus curvature providing the capillary length scale. Competition among capillary, hydrostatic, and viscous stresses is characterized using Bond and Capillary numbers, while thermal gradients contribute thermocapillary forces. Stable detached growth in Sb-based crystals is associated with annular gaps of 30–300μm, a translation rate of 3 mm h^{-1}, and crystal lengths of 1–50 mm and 1–75 mm. Dynamic force balance enables continuous crystal–melt interaction and self-adjustment of growth geometry under 1g. This force-balanced state indicates a quasi-equilibrium, quasi-microgravity-like growth environment with reduced local gravitational influence at the crystal–melt interface.

Keywords: Vertical directional solidification; Sb-based crystals; dynamic annular gap; meniscus control; entirely detached growth.

ICEMSET-2026/FS/INV/337

Comparative Evaluation of MASAM Oil through Snehapana, Abhyanga and Matra Basti in Vishwachi (Cervical Radiculopathy): An Ayurvedic Clinical Study with Neurophysiological Correlation

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Abstract

Vishwachi, a Nanatmaja Vata disorder described in classical Ayurvedic texts, clinically resembles cervical radiculopathy, characterized by neck pain, restricted cervical movements, radiating pain and neurological deficits. Classical management includes *Snehapana*, *Abhyanga* and *Basti*. The present study evaluated MASAM oil, formulated with nerve-nourishing and anti-inflammatory herbs, through these three routes of administration. Patients diagnosed with *Vishwachi* clinically correlating with cervical radiculopathy were treated for 21 days with MASAM oil administered through *Snehapana*, *Abhyanga* or *Matra Basti*. Therapeutic response was assessed using the Numerical Pain Rating Scale, cervical Range of Motion (ROM), Neck Disability Index

(NDI), and Nerve Conduction Studies (NCS). Intergroup changes were statistically analyzed to compare the effectiveness of the three therapeutic routes. All three interventions demonstrated improvement in pain, NDI and cervical ROM. *Matra Basti* produced greater reduction in pain and improvement in NDI compared with *Snehapana* and *Abhyanga* ($p<0.001$). Improvement in cervical ROM was observed in all groups, with *Abhyanga* showing notable improvement. NCS demonstrated significant changes in latency ($p=0.031$), amplitude ($p<0.001$) and conduction velocity ($p<0.001$), with *Abhyanga* showing greater improvement in motor nerve conduction, while *Matra Basti* demonstrated superior improvement in sensory nerve conduction. MASAM oil demonstrated beneficial analgesic, anti-inflammatory and neuroprotective effects in *Vishwachi*. Among the three routes, *Matra Basti* showed the most consistent overall clinical improvement, while *Abhyanga* showed notable neurophysiological benefits.

Keywords: *Vishwachi*; Cervical Radiculopathy; MASAM Oil; Matra Basti; Snehapana; Abhyanga; Nerve Conduction Study.

ICEMSET-2026/FS/INV/338

Flood Spreading and Dryland Rangeland Restoration: Ecological Evidence and a Framework for Earth Observation-Based Monitoring

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Abstract

Flood spreading is an important water-management and rangeland-restoration practice in arid and semi-arid regions, where improved soil moisture can enhance plant establishment, forage production, and vegetation cover. A review of studies from 17 flood-spreading stations across Iran showed that forage production increased by approximately 2 to 1,160 kg ha^{-1}, while vegetation cover increased by 2 to 38 percentage points. The magnitude of ecological response varied considerably among sites, reflecting differences in climate, soil properties, flood hydrology, and rangeland management. Building on these findings, this presentation discusses the potential of integrating field-based ecological indicators with satellite time series and climatic data to improve long-term assessment of flood-spreading effectiveness. An Earth observation-based monitoring framework is proposed to help distinguish management effects from climatic variability and to support adaptive and sustainable management of dryland rangelands.

Keywords: Flood spreading; Rangeland restoration; Earth observation; Ecological monitoring, Adaptive management.

ICEMSET-2026/FS/INV/339

Ecofriendly stratagies for the synthesis of graphene-based composites for high performance supercapacitor devices

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Abstract

Surging global energy demand, driven by the depletion of fossil fuels like natural gas, crude oil, and coal, poses a fundamental challenge to modern energy systems. Conventional fossil fuel power generation accelerates carbon dioxide emissions, global warming, and environmental pollution, while nuclear power carries inherent disaster risks. Achieving sustainable energy security requires transitioning to environmentally benign energy sources, combined with efficient conversion and storage technologies. Supercapacitors, or Electrochemical Double-Layer Capacitors (EDLCs), offer key operational advantages over commercial lithium-ion batteries,

including high power density, rapid charge/discharge rates, and superior cycle life. However, their widespread adoption remains constrained by low energy density and insufficient ionic conductivity, driving the need for advanced electrode materials. Graphene and its composites stand out as prime candidates due to their high surface area, excellent electrical conductivity, and cost-effectiveness. This study investigates eco-friendly synthesis pathways for graphene-based composites (e.g., rGO-Au, graphene-chromium oxide, and rGO-Ag) and evaluates their performance as electrodes in both supercapacitor and coin cell applications.

Keywords: Graphene, Supercapacitor, EDLC, Energy Storage Devices, Ecofriendly.

ICEMSET-2026/FS/INV/340

Multifunctional Nanostructured Materials: A new dimension in Energy Storage Materials

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Abstract

Multifunctional materials are of today's quest. Miniaturization, i.e. development of these materials in the form of nanomaterials is of primary need considering their application in devices. Moreover, if these are obtained in nanostructured form, they can bring wonders. Recently, a we have adopted for developing multiferroic $BiFeO_3$ (BFO) with simultaneous antiferromagnetic, ferroelectric & ferroelastic behaviour in form of nanostructures like nanorods, nanowire etc. by employing Anodised Alumina (AAO) template with various pore sizes from 20nm with solution route followed by controlled vacuum filtration and sintering. Diameters of nanorods are in the range of 20-100 nm as observed by FESEM. Capacitance assayed by cyclic voltammetry (CV) and charge discharge processes reveals a very high value of specific capacitance of 450F/gm. Capacitance has been estimated by extrapolating the charge collected at the electrode to that at scanning rate of infinity which is relevant for the charge collected at the nanorods protruding out of the template. Charging and discharging times are quite constant over a large number of cycles. This large value of specific capacitance can be attributed to the nanostructure form of BFO nanorod. The high value of specific capacitance of BFO nanorods brings forth its use as electrode in storage energy devices. Also, a high value of polarization as well as a significant magnetic susceptibility are observed in multiferroic Bismuth Ferrite (BFO) in the form of nanorods protruding out. The high values of polarization and magnetic susceptibility are attributed to the structured form of BFO nanorods giving rise to the directionality. There is no leakage current in P-E loop examined at various fields and frequencies. Magnetocapacitance measurements reflect a significant enhancement in magnetoelectric coupling also. We have also developed a variety of conducting polymer (like PANI, PEDOT etc.) and graphene-based nanocomposites with a large value of specific capacitance for use as energy storage device. Low energy ion source available at VECC is a useful tool to develop various nanostructures like nanoripples, nanopillars etc. Some novel nanopillars of Ni have been developed using low energy ion beam irradiation.

ICEMSET-2026/FS/INV/342

Computational Design of Tunable Optical Properties in Twisted Trilayer Graphene for Reconfigurable Communication Technologies

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Abstract

Twisted multilayer graphene offers a versatile platform for engineering tunable electronic and optical properties through rotational stacking and moiré superlattices. In this work, we develop a theoretical framework for n-layer twisted graphene and apply it to AAA-stacked, alternating-twist twisted trilayer graphene (TTLG) using a generalized Bistritzer–MacDonald continuum model. The electronic band structure is calculated for representative twist angles, revealing mirror-symmetric and mirror-antisymmetric low-energy sectors and pronounced flat-band formation at reduced twist angles. We further investigate optical matrix elements for linear and circular polarizations and calculate the one-photon absorption coefficient. The absorption spectra

exhibit a Fano-type resonance whose spectral position can be tuned across the near-infrared regime by varying the twist angle, while the non-resonant background remains relatively stable. These results highlight TTLG as a promising platform for twist-programmable infrared photodetectors, tunable optical filters, and polarization-selective modulators for reconfigurable optical communication and sensing technologies.

Keywords: Twisted Trilayer Graphene; Moiré Superlattices; Optical Response; Fano Resonance; Reconfigurable Optical Communication.

ICEMSET-2026/FS/INV/343

Smart agriculture and smart livestock farming for the sustainable production – challenges and solutions

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Abstract

Smart farming involves utilizing cutting-edge technologies and data-driven farm operations to maximize and enhance sustainability in agricultural output. "Smart Farming Technologies" is a new component that aims to improve agricultural operations' sustainability and production. The smart livestock farming leverages technology to boost production and meet food demand. Application of smart technologies in animal production, covering opportunities, challenges and solutions. Smart agriculture employs modern technology to enhance efficiency, sustainability and animal welfare in livestock farming which includes remote monitoring, GPS-based animal care, robotic milking, smart health collars, predictive disease control, and other innovations to achieve these goals. Tracking animal locations inside and outside of farms, observing patterns in livestock behaviour, early disease detection of crops, less crop waste, and effective crop harvesting are just a few ways farmers can profit from SFT. This strategy aims to improve agricultural productivity, sustainability, and efficiency by leveraging drones, sensors, and data analytics. The farms and agricultural locations that use smart farming techniques are known as smart farms. Farming with brains! It uses technology like sensors, drones, robots, and even AI to make farming more efficient, sustainable, and profitable.

Keywords: Smart agriculture farming- smart livestock farming – GPS based animal tracking -robotic milking.

ICEMSET-2026/FS/INV/344

Investigation of optical and shielding features of lead fluoride cadmium bismuth borate glasses

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Abstract

Researchers are drawn to create new glass materials for a number of uses because of the intrinsic qualities of glasses, such as homogeneity, composition diversity, transparent and have a low cost unlike other materials. In this work the glass samples were prepared with the formula of $xPbF_2$-10CdO-20Bi_2O_3-(70-x) B_2O_3 (where x=0, 10, 20, 30 and 40 mole%) by using melt quenching method. the variation of physical and optical properties of cadmium bismuth borate glasses with change in lead fluoride content were studied. The results show that with the enhancement of lead fluoride content both density and molar volume of the samples increased. From UV-Vis spectra Optical band gap (E_{opt}), Urbach energy(ΔE) eV, and Refractive index (n) were determined. The optical band gap value changed from 2.568 eV to 2.481eV as the PbF_2 content increased from 0 to 40 mole%. High density value indicates that prepared samples were useful in radiation shielding application.

Keywords: density, optical band gap, Urbach energy, Bismuth borate glass.

ICEMSET-2026/FS/INV/345

Applications of Chaotic Optical Communication

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Abstract

In certain circumstances, chaotic oscillations can be seen in a nonlinear system with feedback. The behavior of chaotic systems is uncertain due to their extremely complicated evolution throughout time. Chaotic paths separate from one another over time. As such, safe cryptography is where chaos theory is most commonly applied. Several optical devices that have been investigated in literature for producing optical chaos include lasers, Mach Zehnder interferometers, and acoustic-optical systems incorporating electronic feedback. Studies have shown that feedback in nonlinear systems can be a useful tool for characterizing chaotic paths. Measures that express the degree of uncertainty in chaotic dynamics, such as Kolmogorov entropy or Lyapunov Exponents, are frequently used by researchers to quantify chaos. Every dynamic system's trajectory changes when noise is present, thus in order to understand noise's impacts in this context, I read through a number of research publications, as shown in the section below. With the use of nonlinear optical devices, this work intends to demonstrate the uses of chaos in a chaosbased communication strategy and to successfully retrieve the message from the receiver side. Ultimately, a gap analysis is carried out to identify the gaps in current research trends and to suggest directions for further investigation.

Keywords: Chaos, Optics, Entropy, Bifurcation, Communication.

ICEMSET-2026/FS/INV/346

Evaluation and Correlation of Strength Properties of Mortar Incorporating Stone Waste

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Abstract

Stone, like other construction materials, is a critical component of any building. The expansion of stone industries in India and around the globe produces stone waste on a massive scale during a variety of operations. Stone waste is also dumped into water bodies and open land, causing water and soil pollution. As the slurry evaporates, it contaminates the atmosphere and induces health issues. Miners in stone quarries have high rates of lung illnesses, such as silicosis. Furthermore, the transportation and disposal of these contaminants on open land would result in additional costs. The construction industry may utilize these wastes as a substitute for basic materials like cement, sand, etc. In this study, Kota stone waste powder was used as a partial replacement for cement in mortar at 0%, 2.5%, 5%, 7.5%, and 10% to evaluate its impact on compressive strength at different curing ages. The correlation between the compressive strength of mortar under air and water curing was derived. The results indicated that adding stone particles enhanced mortar compressive strength to a certain extent, likely due to the pore-filling effect, regardless of curing conditions. Under both curing conditions, compressive strength showed a linear correlation.

Keywords: Stone waste, cement mortar, compressive strength, waste management, correlation, prediction.

ICEMSET-2026/FS/INV/347

The efficacy of combining Sentinel-1 C-band and Sentinel-2 MSI datasets in enhancing reforestation carbon stock estimation in urban landscape

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Abstract

Accurate information on reforested carbon stock inventories is vital in understanding the value of urban reforestation initiatives and its role in designing climate mitigation strategies. However, the carbon stock estimation capabilities of traditional optical sensors are often plagued by saturation issues, clouding, and canopy shadowing effects. Although the fusion of radar and optical spectral data has shown great promise in reducing these challenges, studies on the utility of fused dataset in reforested urban areas remain limited. To this end, this study examined the efficacy of combining Sentinel-1 C-band and Sentinel-2 MSI datasets in enhancing reforestation carbon stock estimation in urban landscape. To this objective, Sentinel-1 C-band and Sentinel-2 MSI image datasets were combined using a nearest neighbour diffused (NND) fusion technique and reforested carbon stock inventories estimated and mapped using a random forest regression model. The best carbon stock model (R^2 = 0.78 – 0.83; RMSE = 0.31 – 0.41 $t.ha^{-1}$) was produced from the fused sentinel dataset. Among the interferometric polarisation, the results show that cross-polarized VH carbon estimates strongly correlate with measured carbon stock (r = 0.98), compared to co-polarized VV (r = 0.96). These results provide a basis to understand the value and versatility of image fusion in improving carbon stock estimation. Hence, the study provides a framework for monitoring reforested urban ecosystems, useful for facilitating sustainable urban living, optimal urban environmental governance and climate change mitigation.

Keywords: reforestation, synthetic aperture radar, polarization, climate change, image fusion, fusion indices.

ICEMSET-2026/FS/INV/348

Biosynthesis of Metallic Nanoparticles (MNs) and Their Applications as Antimicrobial and Biocatalytic Agents in Medical, Agricultural, and Environmental Sectors

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Abstract

Nanotechnology is a novel interdisciplinary science that serves as a nexus between the basic sciences and the life sciences, and the life sciences are no exception. As multi-drug resistance in pathogens has rendered antibiotics ineffective, nanoparticles are the next frontier. Silver nanoparticles have been found to have applications in various fields, including medical, agricultural, and environmental sectors. Due to their enhanced responsiveness to environmentally friendly technology for quantifiable synthesis, several developed nations have seen significant growth in the biosynthesis of metallic nanoparticles, including CuNPs and Ag NPs. The biological method, however, is the most in-demand approach to preparation because it is quicker, safer, less expensive, and more environmentally friendly than other techniques. In addition, the importance of Ag NPs has been extensively examined in light of their numerous applications, including antifungal, anti-inflammatory, antibacterial, and biocatalytic activities, as well as their use in anticancer medicines. MNPs are used as materials for electrical batteries, optical receptors, catalysis, biolabeling agents, sensors, bioactive materials, and antimicrobial agents in biomedical fields. A significant feature of silver is its broad-spectrum antimicrobial activity, attributed to its ability to inhibit microbial colonization associated with biomaterial-related infections. Recent reports indicate that fungi, Viruses, and bacteria are susceptible to silver nanoparticles. In our lab, an eco-friendly biological synthesis of Metallic silver nanoparticles (BioAgNPs) is achieved by reacting silver nitrate with the cell-free filtrate of various microbial sources. *Viz* fungi (*Aspergillus niger*, *Aspergillus flavus, and Agaricus bisporus), Actinobacteria (Actinomycetes), and plant parts (leaves, flowers, stems, etc.) from various plants, such as Piper betle, Ocimum leaves, Azadirachta indica*, *Ficus religiosa, and Ziziphus.* The synthesized AgNPs were characterized by UV-visible spectroscopy, FTIR, SEM, and TEM to examine their morphology, including size, shape, and stability. The probable mechanism for the extracellular biosynthesis of silver nanoparticles was explained. The synthesized silver nanoparticles exhibited excellent antimicrobial and antiviral activity against bacterial strains (*E. coli*, *Staphylococcus*, *Pseudomonas*, *Bacillus spp.*, etc.), including drug-resistant bacteria, plant fungal pathogens (*Sclerotium rolfsii*, *Rhizoctonia bataticola*, etc.), and antiviral activity against *Sesbania mosaic virus*, a causative agent of mosaic disease in Sesbania plants in the agricultural sector. The biocatalytic activity of MNPs has been evaluated against textile dyes, such as Methylene Blue (MB)

and Bromothymol Blue (BTB). The AgNPs exhibited good antimicrobial activity and dye decolorization, which are useful in the medical and environmental sectors.

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Numerical study for the preparation of a bio-based membrane using the Flory-Huggins, Krieger-Dougherty model

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Abstract

This work focuses on the theoretical study of a bio-based membrane developed using polyvinyl alcohol (PVA), citric acid, sodium chloride (NaCl), and olive pomace, intended for water treatment applications. It aims to describe the scientific principles governing the design of this membrane, highlighting the specific role of each of its constituents as well as the physicochemical phenomena occurring during its formation and operation. This work also presents the main mechanisms involved in pollutant separation, particularly membrane filtration and adsorption, before addressing the theoretical modeling of the system using the Flory-Huggins, Krieger-Dougherty, and Response Surface Methodology (RSM) approaches. Finally, the theoretical parameters likely to influence the membrane's performance are analyzed to provide a solid scientific basis for the experimental study presented in the following chapters.

Keywords: Bio-based membrane; Polyvinyl alcohol (PVA); Olive pomace; Flory-Huggins; Krieger-Dougherty.

ICEMSET-2026/FS/INV/350

Rapid elimination through a 3D-printed solid-phase extraction syringe cartridge for enhanced analysis of complex sample matrices

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Abstract

Triclosan (TCS) and its transformation product 2,4-dichlorophenol (2,4-DCP) are emerging contaminants frequently detected in environmental and biological systems, necessitating efficient analytical strategies for their trace-level determination. In this work, a lightweight and porous EB/CMC/PEG-CS (emeraldine base/carboxymethyl cellulose/polyethylene glycol–chitosan) aerogel was synthesized and integrated into a customized three-dimensional (3D)- printed clip-on solid-phase extraction (SPE) syringe filter for rapid sample pretreatment and analyte enrichment. The prepared aerogel exhibited a well-defined interconnected structure with abundant carbon-, oxygen-, and nitrogen-containing functional groups that facilitated analyte adsorption through π–π interactions, hydrogen bonding, and electrostatic interactions. Under optimized conditions, the developed platform, coupled with HPLC-UV/Vis analysis, demonstrated good linearity over the concentration

range of 0.5–100 ng mL^{-1} with correlation coefficients (R2) greater than 0.98. Theintegrated platform showed satisfactory analytical performance with good recovery, acceptable reusability over multiple cycles, and minimal analyte loss during extraction.

Keywords: Polyaniline; Chitosan; Triclosan; Hazardous; Antimicrobial.

ICEMSET-2026/FS/INV/351

Seaweed-Based Innovative Materials for Potential Applications

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Abstract

India has ~7500 km long coastline that is accessible for seaweed activities such as seaweed farming. Seaweeds represent one of the most important and promising sources for commercially important products namely seaweed polysaccharides (e.g., agar, agarose, carrageenan, alginate, etc.). Furthermore, seaweeds and their products have been widely used as key ingredients in food and pharmaceutical preparations like ice creams, dairy products, meat products, tablets, as stabilizers in syrups & cosmetics, and healthcare products, as well as biodegradable thin films in the packaging industry. In India, CSIR-CSMCRI has developed indigenous technologies for the commercial production of phycocolloids (e.g. agar, agarose, carrageenan, alginate), packaging materials, healthcare products, biostimulants, etc. from seaweeds under value addition programme of Indian seaweeds. I have also developed seaweed-based innovative materials for potential uses such as energy materials, supercapacitor materials, as well as materials for sensors, environment remediation, wound dressing, packaging, etc. In this talk, I will provide a comprehensive review on eco-friendly technologies for the production of functional carbon materials using seaweed biomass and their potential uses.

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Staphylococcus aureus FAD Synthetase as a Potential Target for Novel Antimicrobials

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Abstract

Staphylococcus aureus is a formidable pathogen requiring novel therapeutic strategies. Flavin adenine dinucleotide synthetase (FADS) is essential for bacterial survival, catalyzing the synthesis of vital flavin cofactors. Unlike independent eukaryotic homologs, *S. aureus* FADS (SaFADS) is a bifunctional enzyme featuring fused riboflavin kinase (RFK) and FMN adenylyltransferase (FMNAT) domains. Our study reveals an obligate structural assembly where the RFK domain and native inter-domain linker are essential for stabilizing the FMNAT active site; isolated FMNAT is catalytically inactive. Furthermore, kinetic and structural analyses highlight specific residues, such as F26, as crucial for substrate stabilization. Because SaFADS exhibits pronounced inter-domain dependence and specific binding configurations distinct from human homologs, disrupting this structural coupling or targeting these unique active sites offers a promising, pathogen-specific strategy for developing novel antimicrobials against resistant *S. aureus* strains.

Keywords: *Staphylococcus aureus*; SaFADS; Inter-domain coupling; Antimicrobial target; Flavin metabolism.

ICEMSET-2026/FS/INV/353

Heterointerface Engineering of Bi_2S_3/Mo_2S_3–Ag Nanocomposites for Environmental Remediation and Multifunctional Optical Sensing

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Abstract

The Bi_2S_3/MoS_2–Ag (BiS/MoS–Ag) composite was developed as a multifunctional material for textile effluent remediation, photocatalytic degradation, adsorption, and photoluminescence multiplexing. X-ray diffraction and field-emission scanning electron microscopy confirmed its crystalline structure and three-dimensional nanostructured morphology, while UV–visible spectroscopy revealed a bandgap of 3.7 eV. The composite exhibited efficient photoluminescence multiplexing through selective processing of multiple excitation wavelengths into distinct emission outputs. Under visible-light irradiation, the composite degraded Methyl Orange (97%), Methylene Blue (93%), Rhodamine B (90%), and Congo Red (55%), with corresponding rate constants of 0.9153, 0.8842, 0.8641, and 0.8989 min^{-1}, respectively. The C4 dye mixture achieved 83% degradation within 80 min, while real textile wastewater showed 86% degradation. Optimal performance was obtained at pH 7 and catalyst concentrations of 0.02–0.04 g L^{-1}. Adsorption studies yielded a maximum capacity of 74 ng g^{-1}, with thermodynamic analysis confirming a spontaneous and endothermic process. The multifunctional composite demonstrates promising potential for sustainable wastewater treatment and advanced optical applications.

Keywords: Bismuth sulfide; Kinetic model; Photocatalytic; Textile dye; Wavelength multiplexing.

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Imidazole-Doped Fluorescent Carbon Dots from *Mussaenda glabrata* Leaves: Selective Zn^{2+} Sensing and Antioxidant, Antibacterial and Anticancer Potential

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Abstract

Green-synthesized, nitrogen-doped carbon dots (imi-CDs) were prepared hydrothermally from *Mussaenda glabrata* leaf paste, a tropical wild plant, using 4,5-imidazoledicarboxylic acid as a novel nitrogen dopant. UV–Visible, FT-IR, photoluminescence (PL) spectroscopy and FE-SEM confirmed successful doping, characteristic functional groups, strong emission and spherical nanoscale morphology with slight agglomeration. Surface functionalization with Cu^{2+} enhanced fluorescence intensity, whereas Zn^{2+} quenched emission, indicating the potential of imi-CDs for selective Zn^{2+} detection. Biological evaluation showed concentration-dependent antioxidant activity in the DPPH assay (IC_{50} = 291.844 µg/mL) and notable antibacterial action against *Staphylococcus aureus* and *Escherichia coli* in well diffusion studies. The MTT assay revealed moderate cytotoxicity toward A549 lung adenocarcinoma cells (LC_{50} = 245.107 µg/mL). This simple, cost-effective and eco-friendly approach yields multifunctional carbon dots with promising applications in metal-ion sensing, environmental remediation and biomedical fields.

Keywords: Green synthesis; Imidazole-doped carbon dots; *Mussaenda glabrata;* Zn^{2+} fluorescence sensing; Antioxidant and anticancer activity.

ICEMSET-2026/FS/INV/358

Smart Agriculture and Regenerative Agriculture in Haryana: Integrating Digital Technologies, Resource Conservation and Climate-Resilient Farming Systems

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Abstract

Haryana's intensive agriculture faces groundwater depletion, soil degradation, salinity and alkalinity, declining soil quality, residue-management constraints, rising input costs and climate variability. The research and

published reports suggest that the integration of smart and regenerative agriculture as a pathway towards resource-efficient and climate-resilient farming. Smart agriculture employs Internet of Things sensors, remote sensing, artificial intelligence, machine learning, drones, robotics, precision irrigation, variable-rate application and digital decision-support systems, whereas regenerative agriculture emphasizes soil biological restoration, organic-matter enhancement, crop diversification, residue retention, conservation agriculture, improved nutrient cycling, agroforestry and livestock integration. A Haryana-specific framework is proposed based on agro-ecological zoning, diversified cropping systems and integrated soil-water-carbon monitoring. The approach links digital sensing and predictive analytics with regenerative field practices to improve water productivity, nutrient-use efficiency, soil health, biodiversity and climate resilience. Rice–wheat, maize–wheat, pearl millet–wheat, cotton-based and pulse-inclusive systems offer important opportunities for transition towards data-driven regenerative agriculture.

Keywords: Smart agriculture; Regenerative agriculture; Artificial intelligence; Precision farming; Soil health.

ICEMSET-2026/FS/INV/359

Thermal durability study of geopolymer prepared from industrial waste

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Abstract

In this present study, high strength inorganic polymers (geopolymer) was prepared by using fly ash from north eastern region of India followed by thermal durability study. Fly ash powder was used as the starting raw material and solution of sodium hydroxide and sodium silicate was used as alkaline activators. Mechanical testing of geopolymer specimens was carried out and the maximum value of compressive strength (73 MPa), flexural strength (14 MPa) and Vickers hardness (153HV) was achieved and the achieved data were confirmed by characterizing the specimens by FESEM-EDS, TEM, FTIR, and XRD techniques as well. To observe the thermal stability, the optimized geopolymer specimens were exposed to elevated temperatures of upto 1000 °C. After exposure, the compression test of the exposed specimens was conducted to reveal the residual compressive strength. The fractured surfaces of exposed specimens were analyzed by using FESEM-EDS and XRD.

Keywords: Inorganic polymers, Fly ash, Mechanical testing, Thermal durability, FESEM.

ICEMSET-2026/FS/INV/362

From Data to Decisions: Explainable and Trustworthy AI for Smart Agriculture

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Abstract

Nowadays, agriculture is becoming more dependent on data analytics, which are based on the use of sensors, IoT devices, remote sensing and AI to analyse crops, soil, environment, weather conditions, etc. But it is not enough for the farmer to get an accurate prediction, he needs to be aware of why AI makes certain recommendations and how sure AI is about its predictions. The topic of this talk is to present an explainable and uncertainty-aware approach to building trusted smart agricultural systems. In this research, the authors propose a framework, which integrates the data from soil, environment, IoT sensors, and agricultural datasets to make intelligent recommendations and decisions regarding crop recommendations. Explainable AI methods, specifically SHAP value analysis, are utilized to find the most influential features of AI prediction, whereas uncertainty estimation gives an estimate of the confidence of AI prediction. As a result of experiments, it was found that the combination of the soil and environmental data improves the crop recommendation quality compared to individual datasets. Thus, this research shows how AI can go from making predictions to making understandable and trustworthy recommendations. The presented approach may be useful for the implementation of precision farming, sustainable resource management and the development of future smart agrifood ecosystems.

Keywords: Explainable Artificial Intelligence; multi-source agricultural feature fusion Learning; Agricultural Decision Support; Crop Recommendation; SHAP; Explanation Consistency; Precision Agriculture; Trustworthy AI.

ICEMSET-2026/FS/INV/363

Green and Sustainable Materials for Emerging Contaminants Remediation

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Abstracts

Water resources and their contamination by toxic pollutants have become a major environmental concern for society, policymakers, and government bodies globally. In this research work, we discussed the various aspects of green materials and their application in the remediation of emerging contaminates including pharmaceuticals and bisphenol-A. The green method was adopted to synthesize several materials like iron oxide, zinc oxide, graphene-like porous carbon, magnetic rice straw biochar (MRSB) and phosphoric acid–activated rice straw biochar (ARSB), calcium oxide (CaO) and KOH modified activated biochar using sawdust carbon, Eucalyptus, Citrus limetta, Eggshell and water hyacinth respectively. The maximum adsorption capacity was 56.68 mg/g for TC and 62.36 mg/g for DF using green-synthesized Fe_2O_3 nanoparticles. The maximum adsorption of graphene-like porous carbon (GPC) for Diclofenac (DF), Tetracycline (TC), and Ciprofloxacin (CF) was found 71.4%, 73.9%, and 83.2%, respectively, under optimal conditions. Similarly, the maximum adsorption of Tetracycline was found to be 44.40% and 70.20% for magnetic rice straw biochar (MRSB) and phosphoric acid–activated rice straw biochar (ARSB) under optimized conditions. In the RSM study, CaO-Biochar achieved the highest optimal removal percentage (80%) for Tetracycline. Langmuir maximum adsorption capacity of CaO-Biochar was 86.98 mg/g for TC. The green materials are widely used in pollutant removal due to their unique properties, including eco-friendly nature, cost-effective synthesis, easy availability, less toxicity, small size, and large surface area. The regeneration studies confirmed the stability and reusability of green materials.

Keywords: Green materials; Emerging Contaminants; Nanomaterials; Water Treatment: Green chemistry, Biowaste.

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Impact of Sewage water irrigation on yield of different crops

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Abstract

The constrain in availability of the fresh water for irrigation, waste water especially sewage water is being used for irrigation of agriculture field. Water consumption is rising faster than the human population in several regions of the world. Reusing wastewater is an excellent approach to mitigating water scarcity. In this study soil samples taken from a sewage irrigation and ground water irrigation area. Samples were collected from various sewer disposal sites (Karnal, Panipat and Hisar) in Haryana where these waters are directly used for irrigation the crops. In Karnal district, the per cent increase in the yield of rice and wheat were 2.13 and 4.57 over non-sewage water irrigation during 2019-20. Similarly, in Panipat, the rice yield was 1.68 per cent higher under sewage water irrigation over non-sewage water irrigation. The per cent increase in the pearl millet yield in hisar was 8.17 under sewage water over non-sewage water irrigation. Similarly, the per cent increase in the wheat yield under sewage water irrigation was 3.69 over the wheat yield under non-sewage water irrigation during 2019-20. Similar trend has been reported during 2020-21 in the yield of rice, wheat and pearl millet in Karnal, Panipat and Hisar districts.

Keywords: Rice, Wheat, Pearl millet, Yield, Non-sewage water and Sewage water.

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Influences of Contact Parameters on the Wear-Protective Tribofilm Formation for Surface Protection and Reliability of Rolling-Sliding Contacts

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Abstract

Operating rolling-sliding contacts, such as those in bearings and gears, under mixed friction often face wear-related challenges that adversely affect performance and reliability. Lubricant additives can form wear-protective tribofilms on contacting surfaces and mitigate such damage. However, the effects of operating conditions and additive properties on tribofilm formation are not fully understood. This study investigates the effects of key contact parameters—rolling speed, slide-roll ratio (SRR), temperature, and additive concentration—on tribofilm formation using a twin-disc tribometer. A two-step experimental approach is followed. First, tribofilm formation is investigated through a full-factorial variation of contact parameters. Subsequently, the wear-protection capability of the generated tribofilms is evaluated by rerunning them under wear-critical conditions. The surfaces are characterized using SEM, EDX, and EPMA to correlate tribofilm composition, homogeneity, and morphology with wear protection. The results reveal the formation of diverse tribofilms with varying levels of wear protection. Notably, tribofilms formed at 100 °C under pure rolling (SRR = 0%) exhibit excellent wear protection and outperform those formed under other investigated conditions. The study highlights the strong coupling between contact parameters and tribofilm development, providing insights into the design of more reliable lubricated machine elements.

Keywords: Tribology; Surface protection; Tribofilm; Wear.

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Quantum Frontiers: 2D Quantum Materials and Quantum Technologies

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Abstract

The rapid development of quantum technologies is creating new opportunities for information processing, secure communication, precision sensing, and quantum imaging. At the heart of many of these technologies are nonclassical states of light, particularly entangled photon pairs (EPPs) at room temperatures, which constitute an essential resource for quantum communication, computing, sensing, imaging, and cryptography. Conventionally, EPPs are generated through spontaneous parametric down-conversion (SPDC) in bulk nonlinear crystals. However, the emergence of two-dimensional quantum materials (2DQMs) offers a fundamentally different platform for nonlinear and quantum photonics due to its promising quantum phenomenat at an atomic level. In this presentation, I will discuss the nonlinear quantum-optical properties of two-dimensional quantum materials (2DQMs) including dilute magnets, supported by theoretical insights. Particular emphasis will be placed on how magnetic interactions and external magnetic fields modulate the nonlinear optical response of dilute-magnetic 2D materials, including the physical origin of their anisotropic and direction-dependent behavior. I will then examine the mechanisms underlying entangled photon-pair generation in atomically thin systems and the opportunities they offer for quantum-light generation. Additionally, I will highlight pathways toward room-temperature, chip-integrated quantum photonic devices, with potential applications in quantum communication, sensing, and information processing. Finally, I will discuss the magnetic switching effect in a 2D dilute magnetic semiconductor monolayer, driven by spin-to-spin conversion and possible quantum information applications.

Keywords: 2D quantum materials; dilute magnets; Spintronics, entangled photons; quantum technology.

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Production Performance of Pashmina Goats of Ladakh under Improved Technological Intervention and Managemental System

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Abstract

The Pashmina internationally known as "Cashmere", a fine luxury fibre, is the prince of the speciality fibres obtained from domestic goats known as "Capra *ibex*". In India the only source of Pashmina is the Changthangi goats of Ladakh which produces the world finest pashmina fibre. These Changthangi goats are reared by the tribal Changpa nomads of Changthang region of Greater Ladakh. At High Altitude Livestock Research Institute, under the AICRP on Changthangi Goat project, 4 clusters namely, Kharnak, Samad, Korzok and Gya village with a total of 40 families having a total of around 13500 pashmina goats were adopted. Scientific breeding intervention, health coverage, shelter management and along with technological intervention like Unique animal identification using all flex tags, Low cost Kid Shelter, Mobile dipping tank, Improvised Pashmina Comb, drum silage and Complete feed using locally available agriculture produce were under taken over a period of 4 years in the adopted flocks. The average pashmina fibre production has increased from 240 gms from the start of project to 367±17.34gm. The mortality percentage has been reduced to 2.6 % from 15%. A population growth of 76.77% has been noticed over a period of 4 years. Improvement in Kidding percentage, birth wt and overall health condition has also been noticed.

Keywords: Changthangi goats, pashmina, fibre, technology, Ladakh.

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Structural Evolution of Graphene Oxide into Reduced Graphene Oxide: Implications for Visible-Light Photocatalysis

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Abstract

Graphene oxide (GO) and reduced graphene oxide (rGO) were synthesized via the modified Hummers method, with rGO obtained through subsequent reduction and annealing to enhance its structural and physicochemical properties. Comprehensive characterization using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), Raman spectroscopy, UV-Vis spectroscopy, zeta potential analysis, Brunauer-Emmett-Teller (BET) measurements, and field-emission scanning electron microscopy (FESEM) confirmed successful oxidation and reduction. GO exhibited a characteristic diffraction peak at 11.6° with an expanded interlayer spacing of ~0.74 nm resulting from oxygen functionalization, whereas rGO displayed graphitic reflections at 25.6° and 44.3° with a reduced spacing of ~0.35 nm. FTIR and Raman analyses further verified the removal of oxygen-containing groups and restoration of the sp^2 carbon network. Under visible-light irradiation, GO degraded Brilliant Green (75.4%), Methylene Blue (69.8%), and Crystal Violet (66%), while rGO achieved higher degradation efficiencies for Brilliant Green (87%), Methyl Orange (83%), and Ciprofloxacin (76.2%). Reusability studies demonstrated excellent stability, highlighting their potential for sustainable environmental remediation.

Keywords: Graphene Oxide (GO); Reduced Graphene Oxide (rGO); Modified Hummers Method; Visible-Light Photocatalysis; Environmental Remediation.

ICEMSET-2026/FS/INV/371

Beyond Li-Ion: Engineering Long-Cycle, High-Rate Lithium–Sulfur Batteries for Sustainable Electric Transportation

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Abstract

Present-day electrification of transportation relies almost exclusively on Li-ion battery technology. While significant progress has been made in engineering battery components and packs, concerns remain regarding (a) safety, (b) energy density (250–300 Wh/kg), (c) the sustainability of battery components, given that state-of-the-art NMC cathodes depend on Ni, Mn, and Co, and (d) cost (100–200 $/kWh). The global effort is therefore focused on finding alternatives and transitioning beyond intercalation-based Li-ion battery technology. One of the most promising candidates is the lithium–sulfur (Li–S) battery, which offers a practical energy density of 350–600 Wh/kg, inherent safety, and significantly lower cost (36–130 $/kWh). This conference will discuss critical innovations to overcome two key challenges in Li–S technology: (a) the polysulfide shuttle effect, which limits cycle life, and (b) sluggish Li–S reaction kinetics, which limit current density.

ICEMSET-2026/FS/INV/372

Solvent-Mediated Synthesis of Nickel Based Metal–Organic Framework for Supercapacitor Application

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Abstract

Nickel-based metal–organic frameworks (Ni-MOFs) have attracted considerable attention as promising electrode materials for better electrochemical energy storage applications. In this present study, Ni-MOFs were successfully synthesized using solvothermal route using ethanol and methanol as a solvent. The synthesized materials were systematically characterized using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FT-IR), and scanning electron microscopy (SEM). Furthermore, electrochemical measurements were carried using CV, GCD, and EIS to evaluate their charge storage capacity and electrode performance of the material. The comparison of the ethanol and methanol derived Ni-MOFs demonstrates that the choice of solvent can influence the structural and morphological characteristics and consequently affect their electrochemical response. This study highlights the importance of solvent selection as a simple synthesis parameter for tailoring the properties of Ni-MOFs for potential electrochemical energy-storage applications.

Keywords: Ni-MOF, Solvothermal, Ethanol, Methanol, Supercapacitor.

ICEMSET-2026/FS/INV/373

$SnSiGeN_4$ Photocatalyst for Water Splitting and H_2 Generation

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Abstract

The development of efficient and cost-effective catalysts for clean energy conversion remains a central challenge in materials science. Although platinum serves as the benchmark catalyst, its scarcity and high cost

hinder large-scale deployment. In this study, we propose a newly predicted SnSiGeN4 MXene-family monolayer as a promising candidate for the oxygen evolution reaction (OER), oxygen reduction reaction (ORR), and hydrogen evolution reaction (HER). Using first-principles calculations, we systematically investigated its electronic, vibrational, and optical properties across multiple exchange-correlation functionals, including hybrid approaches, revealing a wide and tunable band gap. Simulated infrared and Raman spectra further confirm the dynamical stability and the presence of catalytically active sites. Guided by these findings, we studied photocatalytic reaction analyses that demonstrate that the computed overpotentials for OER, ORR, and HER are comparable to those of Pt-based catalysts and outperform Ir-based systems, positioning SnSiGeN4 as a sustainable, high-performance platform for next-generation UV-visible-light-driven photocatalysis.

ICEMSET-2026/FS/INV/374

Iron self-doped porous carbon derived from expired iron supplement tablets for high-performance flexible supercapacitor

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Abstract

The development of sustainable and mechanically flexible electrode materials is important for emerging energy-storage technologies and portable electronic devices. In this study, porous Fe-doped activated carbon (Fe-AC) was prepared using expired iron supplement tablets as a waste-derived precursor and investigated as an electrode material for flexible supercapacitors. The synthesized Fe-AC was systematically characterized to elucidate its structural, morphological, and surface properties. A flexible electrode was fabricated by integrating Fe-AC onto an aluminium-grafted polyimide (Al–PI) substrate, and its electrochemical behavior was evaluated using cyclic voltammetry, galvanostatic charge–discharge, and electrochemical impedance spectroscopy. The Fe-AC@Al–PI electrode exhibited predominantly surface-controlled charge storage, contributing 61.17% of the total capacitive response, while diffusion-controlled processes accounted for 38.82%. A specific capacitance of 200.84 F g^{-1} was achieved at 0.5 A g^{-1}, accompanied by a charge-transfer resistance of 7.14 Ω. A symmetric flexible supercapacitor assembled using the Fe-AC@Al–PI electrodes delivered an energy density of 14.89 Wh kg^{-1} at a power density of 250 W kg^{-1} within a 1.2 V operating voltage window. The practical applicability of the device was demonstrated by powering a 1 V LED using series-connected cells. Furthermore, the device retained its characteristic electrochemical response under bending angles of 45°, 90°, and 180°, confirming its mechanical flexibility and electrochemical stability. These findings demonstrate a promising route for converting expired iron supplement tablets into value-added Fe-doped porous carbon electrodes for flexible electrochemical energy-storage applications.

Keywords: Activated carbon; Recycle; Flexible electrode; Iron dopant; Supercapacitor.

ICEMSET-2026/FS/INV/375

Waste-to-Resource Composite Materials for Fluoride Groundwater Remediation: A Review of Regeneration, Circularity and Life-Cycle Assessment

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Abstract

Fluoride contamination of groundwater remains a serious concern in many regions of Rajasthan, where people depend on wells & tube wells for drinking and irrigation. Fluoride enters water naturally through rock weathering and mineral dissolution; its small amounts protect teeth, but long-term intake above the WHO limit of 1.5 mg/L can cause dental and skeletal fluorosis. Adsorption is among the most studied removal methods because it is simple, flexible, and works with many materials, from modified minerals and biomass to metal oxides, polymers, and composites. Yet strong removal capacity does not make an adsorbent sustainable, because production, activation, transport, regeneration and disposal all add environmental burdens. This review will examine recyclable composites for treating fluoride-affected groundwater, focusing on circularity, reusability,

and life-cycle assessment. It discusses removal mechanisms, the effects of pH, competing ions, and water chemistry, and a framework for turning waste into regenerable adsorbents. Key gaps include testing in real groundwater, fixed-bed studies, regeneration efficiency, safe handling of spent adsorbents, and standardised assessment methods.

Keywords: Fluoride Removal; Groundwater Remediation; Recyclable Composite Adsorbents; Adsorbent Regeneration; Life-Cycle Assessment, etc.

ICEMSET-2026/FS/INV/376

Nanostructured Photocatalysts for Emerging Contaminant Removal and Sustainable Environmental Remediation

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Abstract

Photocatalytic metal oxide nanostructures have become attractive materials for environmental remediation and sustainable water purification because of their adjustable physicochemical characteristics, high surface-to-volume ratio, and effective production of reactive oxygen species under light irradiation. The design and development of metal oxide nanostructures and their composites for the degradation of developing contaminants in water, such as dyes and nanoplastic pollutants, is our main focus. To improve light absorption, charge separation, and photocatalytic activity, special attention is paid to regulating particle size, morphology, surface defects and heterojunction interfaces. Pollutant mineralisation can be enhanced and electron-hole recombination further suppressed by the synergistic integration of semiconductor metal oxides with appropriate metallic or carbon-based components. The objective of the suggested strategy is to create effective, affordable photocatalytic systems that may be used to treat wastewater using solar energy.

Keywords: Metal oxides, Photocatalysts, nanoplastics, nanostructures, heterojunction.

ICEMSET-2026/FS/INV/377

Tailoring Transition Metal and Rare-Earth Ion Doped Oxide Glasses for Optical Filters and White LEDs

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Abstract

Oxide glasses are exceptionally versatile hosts for optically active ions, offering compositional flexibility, ease of fabrication and excellent transparency. The work presents an overview of research on phosphate, borate and silicate glasses doped with transition metal and rare-earth ions. Systematic investigation of their physical, structural, morphological, thermal, mechanical and optical properties shows how the type and concentration of dopant govern the glass network and its interaction with light. In zinc lead lithium phosphate glasses doped with Cr^{3+} and V_2O_5, and in copper-doped lithium phosphate glasses, the dopant ions produce characteristic absorption bands. Together with high density and thermal stability, these bands make the glasses promising candidates for optical band pass filters. Praseodymium-doped lithium borate and europium-doped silicate glasses exhibit strong visible emission with colour characteristics suited to white light-emitting diodes and other optoelectronic devices. The presentation covers rational design of glasses, and future directions towards multifunctional photonic materials.

Keywords: Oxide glasses; Transition metal ions; Rare-earth ions; Optical band pass filters; W-LED; Thermal stability.

ICEMSET-2026/FS/INV/378

Climate smart Agriculture for sustainable food security

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Abstract

Agriculture is the largest food provider in India, with more than 50 percent of the population dependent on it. Climate change and climate variability are causing irregular precipitation, rising sea levels, and frequent extreme weather events, which threaten agricultural crop production through prolonged droughts, floods, and shifting agroclimatic zones. Climate smart agriculture or Climate resilient agriculture is set of agricultural systems to anticipate and prepare for extreme weather conditions, as well as to adapt, absorb and recover from the impacts of climate change. It integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges. Climate smart agriculture focuses on sustainable agricultural productivity by adapting and building resilience to climate change and increases resource use efficiency by reducing greenhouse gases emissions. Due to lack of knowledge, resources, financial constraints, policy barriers Indian farmers are not much interested in adopting climate smart techniques. Different training programs, government supportive policies, financial incentives etc. are required to overcome these challenges and ensure sustainable food security.

Keywords: Sustainable agriculture, climate change, climate smart agriculture, food security, soil health, biodiversity, policy barriers.

ICEMSET-2026/FS/INV/379

Investigation of Photocatalytic Activity and Cyclic Voltammetric Response of Nickel Pyrophosphate Nanoparticles

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Abstract

Nickel pyrophosphate ($Ni_2P_2O_7$) is an interesting material with use in energy storage devices and super-capacitors. The surfactant – *mediated* approach is used to synthesis nickel pyrophosphate nano particles and further analyzed by using Powder XRD and TEM for confirmation of nano-structured nature. Methylthioninium chloride or popularly known Methylene blue (MB) organic dye is chosen for the photo-catalytic study using nickel pyrophosphate nano-particles. Due to large industrial use the MB is found in wastewater and hence the decomposition of MB has become a degradation standard practice. For photo-degradation of MB by nickel pyrophosphate nano-particles is confirmed through several analyses, viz., wastewater analysis, total organic carbon (TOC) analysis, ion chromatography and UV -Vis. The results indicate that MB degrades in lower molecular leuco-dye. This gives an important application of synthesized nickel pyrophosphate nano-particles in an organic pollutant removal. To evaluate the electro-chemical properties of nickel pyrophosphate nano-particles the electro-chemical impedance (EIS) spectral analysis is reported. Nickel pyrophosphate nano-particles are found to be potential photo-catalysts for MB dye degradation. The cyclic voltammetry study was carried out to ascertain the application potential for supercapacitors.

Keywords: Nickel pyrophosphate nano-particles, photo-catalytic activity, Wastewater treatment, Dye degradation, EIS spectroscopy.

ICEMSET-2026/FS/INV/380

Detection of Hg^{2+} Ions by 1,2,3-Triazole Based Chemosensor: Computational DFT and Docking Analysis

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Abstract

The design and synthesis of sensors that can efficiently, sensitively, and cost effectively detect environmental pollutants is a critical societal need now. In this work, the effect of Hg^{2+} ions on the UV-Vis absorbance responses of organosilane where thiosemicarbazone-1,2,3-triazole bonding is prefabricated with heterocycle is described. A stereoselective, "click chemistry" technique was used to create this chemosensor and its formation was confirmed by the mass spectrometry, IR and NMR (^{1}H and ^{13}C) data. The UV-Vis spectra of chemosensor towards various metal ions indicated their remarkable selectivity for recognition of heavy metal Hg^{2+} ions in the presence of other metal ions with no significant interference. Furthermore, the DFT analysis between chemosensor and Hg^{2+} and molecular docking analysis of the ligand with Escherichia coli DNA gyrase II topoisomerase enzyme were carried out to get the more information about its binding patterns.

Keywords: 1,2,3-Triazole; Silanes; Thiosemicarbazone; Hg^{2+} ions; Docking.

ICEMSET-2026/FS/INV/381

Chitosan-Based Edible Coating: A Smart and Sustainable Approach for Post-Harvest Management of Ber

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Abstract

Ber (*Ziziphus mauritiana* Lam.) is an important fruit crop valued for its nutritional and functional properties; however, its high moisture content and rapid physiological deterioration limit its post-harvest shelf life. The integration of smart agriculture with sustainable post-harvest technologies offers an effective approach for minimizing these losses. The present study focuses on the potential of chitosan-based edible coating as a smart and eco-friendly technology for extending the storage life of ber. Chitosan forms a protective semi-permeable film on the fruit surface, thereby regulating gas exchange and reducing moisture loss, respiration, oxidative deterioration, and microbial spoilage. Its application is expected to help maintain important quality attributes such as firmness, total soluble solids, titratable acidity, ascorbic acid, phenolic compounds, and antioxidant activity during storage. Integration of chitosan coating with smart monitoring of storage parameters such as temperature, relative humidity, and changes in fruit quality can facilitate timely assessment and management of post-harvest deterioration. This approach has the potential to reduce post-harvest losses, preserve nutritional and functional quality, extend marketable shelf life, and improve the sustainability of ber production and supply chains. Chitosan-based coating therefore represents a promising component of smart agriculture for sustainable post-harvest management of ber.

Keywords: Ber, chitosan, smart agriculture, post-harvest storage, shelf life, fruit quality.

ICEMSET-2026/FS/INV/382

Synthesis and Corrosion inhibition of Metal Complexes Based on New N'-(4-methoxybenzylidene)-2-phenoxyacetohydrazide Schiff Base

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Abstract

The present study reports the synthesis structural characterization corrosion inhibition performance of N'-(4-methoxybenzylidene)-2-phenoxyacetohydrazide, was synthesized by condensing 2-phenoxyacetohydrazide with

4-methoxybenzaldehyde and its Cu (II), Mn (II), Ni (II), and Zn (II) complexes on mild steel in 1 M HCL solution. The ligand and its complexes were characterized using elemental analysis, FT-IR, UV–Vis, Mass spectrometry and NMR spectroscopy. Spectral data confirmed that the ligand acts as a bidentate donor, coordinating through the azomethine nitrogen and carbonyl oxygen atoms. The corrosion inhibition efficiency of the synthesized Schiff base and its metal complexes was investigated at different concentrations, and the results demonstrated that the synthesized compounds interact with the mild steel surface and reduce its corrosion rate. The anti-corrosion behavior was evaluated by weight loss and electrochemical techniques (EIS and potentiodynamic polarization).

Keywords: Schiff base, metal complexes, corrosion inhibition, mild steel, EIS.

ICEMSET-2026/FS/INV/383

Comparative Analysis of Active and Hybrid Solar Dryers for Sustainable Post-Harvest Management: A Comprehensive Review

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Abstract

Post-harvest losses remain one of the major challenges affecting agricultural productivity and food security worldwide, particularly in developing countries where inadequate drying infrastructure results in significant deterioration of food quality. Solar drying has emerged as an environmentally friendly alternative to conventional fossil-fuel-based drying systems because it utilizes renewable energy, reduces greenhouse gas emissions, and improves the quality of dried agricultural products. Active solar dryers, equipped with forced air circulation systems, have demonstrated superior drying performance compared with traditional open-sun drying. However, their dependence on solar radiation restricts continuous operation during cloudy weather and nighttime conditions. Hybrid solar dryers overcome these limitations by integrating solar thermal energy with auxiliary heat sources such as biomass, liquefied petroleum gas (LPG), electric heaters, heat pumps, or thermal energy storage systems, thereby ensuring uninterrupted drying and improved process efficiency. This review presents a comprehensive comparative analysis of active and hybrid solar drying technologies for agricultural applications. The working principles, system configurations, thermal performance, energy efficiency, drying kinetics, economic feasibility, and environmental impacts of both systems are critically reviewed based on published literature. Performance indicators including drying efficiency, drying time, energy consumption, product quality, operational reliability, and cost-effectiveness are comparatively evaluated. Recent advancements involving photovoltaic-assisted drying, phase change materials (PCM), biomass integration, Internet of Things (IoT)-based monitoring, and intelligent control systems are also discussed. The review demonstrates that hybrid solar dryers provide superior thermal stability, shorter drying times, improved product quality, and enhanced year-round usability compared with conventional active solar dryers, although they involve higher initial investment costs. Future research should focus on smart control systems, thermal energy storage, low-cost materials, and decentralized rural deployment to enhance sustainability and promote climate-resilient post-harvest management.

Keywords: Active Solar Dryer, Hybrid Solar Dryer, Agricultural Drying, Renewable Energy, Solar Thermal Energy, Biomass Heating, Thermal Energy Storage, Food Preservation, Sustainable Agriculture.

ICEMSET-2026/FS/INV/385

Probing Temperature Dependent Dielectric Properties of Blood Glucose In The High Frequency Region

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Abstract

Biolological activities are always very difficult to tune with the physical properties. In this work, we are trying to correlate how dielectric properties vary with the glucose level (Fasting and post meals) present in the diabetic

patients of different ages (50 yrs, 60 yrs and 100 yrs) at different temperatures. Dielectric measurements have been carried out using TDR (Time Domain Reflectometer) in the frequency region of 10 MHz -50 GHz and in the temperature range 298.15 K-278.15 K. The study also looking for corroborating dielectric data with the thermodyanamical properties. The observed variations in the dielectric data suggests increase in the dielectric constants towards low temperature while glucose level observed to be decreased towards low temperature for the samples of different ages studied. Though more statistical data is neded to reach to the concreate conclusion but through this study we have tried to correlate dielectric data with biological activity.

Keywords: Dielectric parameter; Biological activity, Blood Glucose; Time Doamin Reflectometer; Thermodynamical Properties.

ICEMSET-2026/FS/INV/386

Advanced Thin Films, Functional Nanomaterials and Quantum Materials for Next-Generation Quantum Computing

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Abstract

The development of next-generation quantum computing requires advanced materials with precisely engineered structural, electronic, optical, magnetic, and quantum properties. Thin films, functional nanomaterials, and emerging quantum materials are increasingly important in developing the material platforms required for quantum information processing, quantum photonics, sensing, and advanced electronic and optoelectronic technologies. This invited talk provides an overview of recent advances in the synthesis, engineering, characterization, and functional applications of these materials, with particular emphasis on their relevance to emerging quantum technologies. The first part of the talk focuses on advanced semiconductor thin films, including doped, composite, and defect-engineered materials, where thickness, composition, crystallinity, morphology, interfaces, and defect states can be tailored to control their electrical, optical, magnetic, and surface properties. The discussion then extends to functional nanomaterials and nanostructured systems, highlighting the influence of reduced dimensionality, quantum confinement, interfaces, and nanoscale defects on material functionality. The emerging class of quantum materials, including two-dimensional materials, wide-bandgap semiconductors, defect-engineered materials, superconducting materials, and other low-dimensional systems, will be discussed as promising platforms for controlling quantum states and developing quantum-enabled devices. Particular attention will be given to the role of material quality, defects, interfaces, coherence, optical interaction, and low-loss behaviour in realizing scalable quantum architectures. The talk will conclude by examining the transition from conventional semiconductor and nanomaterial technologies toward next-generation quantum computing, highlighting the opportunities and challenges associated with material synthesis, thin-film integration, device fabrication, scalability, and stability. The convergence of thin-film technology, functional nanomaterials, and quantum materials is expected to provide new pathways for the development of robust, scalable, and high-performance quantum computing and quantum information technologies.

ICEMSET-2026/FS/INV/388

Deciphering the Molecular Mechanisms of Arbutin in Neurodegenerative Diseases Through Network Pharmacology, Molecular Docking, and DFT Analysis

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Abstract

Neurodegenerative diseases (NDs), including Alzheimer's disease and Parkinson's disease, are characterized by progressive neuronal dysfunction and loss, with current therapies offering limited efficacy. Arbutin, a naturally occurring phenolic glycoside, possesses antioxidant and anti-inflammatory properties that may contribute to neuroprotection. This study aimed to investigate the potential neuroprotective role of arbutin against NDs using an integrated computational approach. Network pharmacology was employed to identify potential targets associated with arbutin and NDs, followed by protein–protein interaction analysis, Gene Ontology, and Kyoto

Encyclopedia of Genes and Genomes pathway enrichment analyses. Molecular docking was performed to evaluate the binding interactions of arbutin with key proteins implicated in neurodegenerative pathology, including acetylcholinesterase, caspase-3, catalase, tumor necrosis factor-α, and dopamine-related targets. The identified targets were primarily associated with oxidative stress, apoptosis, neuroinflammation, neurotransmitter regulation, and neuronal survival. Molecular docking demonstrated favorable binding interactions of arbutin with acetylcholinesterase (−7.6 kcal/mol), caspase-3 (−7.0 kcal/mol), catalase (−9.0 kcal/mol), tumor necrosis factor-α (−8.8 kcal/mol), and dopamine-related targets (approximately −7.0 kcal/mol). These findings suggest that arbutin may influence multiple molecular mechanisms involved in neurodegenerative processes. However, the predicted binding affinities require experimental validation. Arbutin exhibits a promising neuroprotective profile through its predicted interactions with molecular targets involved in oxidative stress, apoptosis, neuroinflammation, and neurotransmitter regulation. These computational findings, together with its reported antioxidant and anti-inflammatory properties, support further investigation of arbutin in neurodegenerative disease models. Comprehensive in vitro and in vivo studies are warranted to validate its molecular mechanisms and therapeutic potential.

Keywords: Arbutin; Network Pharmacology, Molecular docking, DFT, Natural products.

ICEMSET-2026/FS/INV/390

Enhanced Thermoelectric Properties of VFeBi and NbRuP Half-Heusler alloys: A First Principles Study

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Abstract

In the present study, the structural, elastic, mechanical, electronic and transport properties of the VFeBi and NbRuP half-Heusler alloys were examined by extensive first-principles research. The study was conducted using density functional theory (DFT) within the framework of the WIEN2k code. The full-potential linearized augmented plane wave (FP-LAPW) approach wsa used. The generalized gradient approximation (GGA) and the Tran-Blaha modified Becke-Johnson (TB-mBJ) potentials were used to achieve accurate electronic calculations. The band gaps of 0.36 eV and 0.26 eV using GGA (VFeBi), and 0.81 eV and 0.43 eV using TB-mBJ (NbRuP) confirm the semiconducting behavior of both compounds. The computed elastic properties confirm the mechanical stability of the compounds. The transport properties of the studied half-Heusler compounds were systematically analysed. At room temperature, the calculated power factors reached values of 3.05×10^{11} and 2.15×10^{11} W/mK²s using the GGA approach, while values of 3.10×10^{11} and 3.02×10^{11} W/mK²s were obtained with the TB-mBJ method. The significant values of the figure of merit (ZT) are obtained and increases with rise of temperature till 900 K. The favourable thermoelectric performance identifies VFeBi and NbRuP as attractive candidates for advanced thermoelectric energy applications.

Keywords: Half-Heusler, WIEN2k, DFT, Wyckoff, Figure of merit, thermoelectric (TE).

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Design and Performance Analysis of Lung Water Content Using RF Sensor

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Abstract

Pulmonary edema involves excess fluid accumulation in the lungs, making the assessment of lung water content important for respiratory monitoring. This study investigates a radio-frequency (RF) sensing approach using an interdigital microstrip patch antenna to examine changes in electromagnetic response associated with variations in lung water content. The antenna was designed and simulated using CST Microwave Studio under free-space conditions and above a multilayer thoracic model comprising skin, fat, muscle, and lung tissues. The dielectric properties of the lung layer were varied to represent water volume fractions of 40%, 50%, 60%, and 70%, using

parameters derived from established tissue models. Under tissue-loaded conditions, the antenna exhibited a resonant frequency of 2.682 GHz, demonstrating the influence of biological tissue on antenna performance. The simulations provide insight into the relationship between lung dielectric properties and antenna response, supporting further investigation through sensor optimization, fabrication, and experimental validation for potential non-invasive lung water monitoring applications.

Keywords: RF Sensor; Pulmonary Edema; Dielectric Properties; Lung Water Content; Microstrip Patch Antenna.

ICEMSET-2026/FS/INV/392

Prospective Photonic Applications of Silicon Nanostructures Grown by Laser Deposition Techniques

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Abstract

Extensive research has been devoted to functional silicon nanostructures (Si-ns) with tailored optical properties in the emerging fields of communications and optoelectronics including solar cells, laser diodes and photovoltaic detectors. As a result, some Si-ns have now approached or even exceeded the performance of their equivalent direct-bandgap photonic counterparts. Some of the methods to grow such Si-ns are laser-based techniques, which offer much-needed flexibility, low cost and functional advantages. For example, oxidized or micro-porous Si-ns can be produced by laser ablation in deionized water or alcohol with composite luminescence spectral characteristics. Other methods envisage laser ablation-based growth in the gaseous ambience or capping of Si-ns with high band-gap materials for quantum confinement. We carried out experimental studies on the growth of silicon nitride and alumina/SiO_x capped silicon nanoparticles (Si-nps) using pulsed laser deposition (PLD). In the former case, SiN and Si pellets were ablated and in the latter case, we used Al_2O_3 and Si pellets. The composition-controlled capping layers were deposited in the gaseous ambience of nitrogen and oxygen respectively. Multilayer ensembles of Si-nps embedded in silicon nitride matrix were studied to understand the basic optical processes in isolated and capped Si-nps. These studies showed that the photoluminescence (PL) spectra consisted of multiple transitions due to the combined effects of morphological inhomogeneity and quantum confinement of charge carriers in the Si-nps. PLD of Si-nps in oxygen ambient enabled the growth of controlled thickness of SiO_x overlayer around the nanoparticles, which acted as a wide band-gap confinement layer and facilitated blue emission from such Si-nps. The observed emission could be attributed to the transitions from the luminescence centers at the interface between Si-nps and the SiO_x surrounding layers. Such Si-nps are poised for numerous photonic applications. This paper presents an overview of this field based on our experience and current scenario.

ICEMSET-2026/FS/INV/394

Polylactic Acid (Pla) Based Composites: Emerging Alternatives to Traditional Construction Materials

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Abstract

The construction industry faces increasing pressure to adopt sustainable, eco-friendly materials that reduce reliance on non-renewable resources, minimize environmental impact, and address the challenges of plastic pollution and high carbon emissions from conventional materials like concrete, steel, and petroleum-based composites. Polylactic acid (PLA), a biodegradable thermoplastic has emerged as a promising biopolymer matrix for developing high-performance composites. When reinforced with natural fibres or other bio-fillers, PLA-based composites offer a compelling alternative to traditional construction materials. These composites

exhibit tuneable mechanical properties, including improved tensile and flexural strength, stiffness, and impact resistance through reinforcement strategies, while maintaining advantages such as low density, renewability, and full or partial biodegradability. This paper reviews recent advances in PLA-based composites, including processing techniques (e.g., extrusion, injection moulding, and 3D printing), modifications for enhanced durability and thermal stability, and their potential applications in structural elements, panels, insulation, flooring, and non-load-bearing components. Challenges such as limited toughness, moisture sensitivity, and scalability are discussed alongside opportunities for further development to promote circular economy principles in building and construction.

Keywords: PLA composites; natural fibre reinforcement; sustainable construction; eco-friendly building materials; mechanical properties; green composites; construction alternatives.

ICEMSET-2026/FS/INV/395

Design and Simulation of CSpRR Sensor for Water Adulteration Detection in Milk

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Abstract

In this paper, a Circular Spiral Ring resonator (CSpRR), configured as a band-stop filter for detecting water adulteration in milk, is designed to operate in the frequency range of approximately 2 GHz to 4 GHz. The proposed sensor effectively detects changes in the dielectric constant caused by water adulteration in milk, which leads to measurable shifts in resonance frequency and variations in signal magnitude. CST Microwave Studio is used for performing the time and frequency domain analysis of the sensor and the obtained the result. The current work gives an efficient, compact, and non-invasive solution for real-time monitoring of quality milk.

Keywords: Circular Spiral Ring Resonator (CSpRR), Band-stop Filter, Resonator Sensor, Adulteration.

ICEMSET-2026/FS/INV/396

Orchestrating Next-Generation 3D Tumor Models through a versatile Biopolymer-Based Platform

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Abstract

Tumor metastasis accounts for over 90% of cancer-related mortality and is driven not only by tumor cells but also by complex interactions of non-tumor cells within the tumor microenvironment (TME). Three-dimensional (3D) cell culture models, particularly multicellular spheroids, provide physiologically relevant *in vitro* platforms that bridge conventional 2D cultures and *in vivo* systems. Our laboratory has developed a patented deep-tech biopolymer platform for diverse 3D cell culture applications, including TME modelling, tissue engineering, artificial skin, and plant-derived decellularized scaffolds. In this study, cancer and immune cells were co-cultured as 3D models on in-house developed biopolymer substrate. The resulting models were functionally characterized using tumor-associated macrophage (TAM)-specific biomarkers to evaluate cellular interactions within the TME. Ongoing studies employ differential fluorescent labelling of cancer and immune cells to dynamically monitor their interactions using live-cell imaging. These physiologically relevant models facilitate mechanistic studies of cancer progression and development of therapeutic strategies, including immunotherapy.

Keywords: Tumor microenvironment, 3D cell culture models, Biopolymer, co-culture spheroid models.

ICEMSET-2026/FS/INV/398

Unveiling Thickness-Dependent Volumetric Optothermal Energy-Conversion (Self-Heating) Ability of Room Temperature Grown GaN Thin Films on Direct Amorphous Glass Substrate

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Abstract

This study demonstrates an efficient optical-to-thermal energy-conversion (self-heating) capability of room-temperature (RT) grown Gallium Nitride (GaN) thin films on direct amorphous glass substrates using RF magnetron sputtering. This experimental technique eliminates conventional requirements such as substrate heating, pre/post-annealing, or buffer nanolayers. Comprehensive structural and morphological characterizations (XRD, SEM, EDS, TEM/SAED, and AFM) confirm high film homogeneity, quality, and a hexagonal wurtzite polymorphic phase dominated by (101), (002), and (100) planes. Additionally, the effects of RF power and gas flow on growth rate and film quality were evaluated. Finite-difference time-domain (FDTD) simulations analyzed the thickness-dependent optical response, power absorption, and volumetric power dissipation across the UV-visible spectrum. These findings provide a cost-effective, scalable route for manufacturing GaN-on-glass substrates for power, optoelectronic, and energy-harvesting applications while offering key insights into mitigating strain, phase instability, lattice mismatch, and dislocation defects in ultrathin GaN films.

Keywords: GaN thin films, room temperature crystallinity, amorphous (glass) substrate, rf-sputtering, FDTD simulations, volumetric power absorption, optoelectronics.

ICEMSET-2026/FS/INV/399

Towards futuristic Agri-food supply chains through integration of Sensors and Blockchain Technology

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Abstract

Futuristic agri-food supply chains require technologies that can enable real-time monitoring, transparency, traceability, and data-driven management of food products from farm to consumer. Sensor technologies can provide continuous information on critical environmental and quality-related parameters during storage, transportation, and handling, thereby enabling timely intervention and improved supply chain management. However, ensuring the integrity, transparency, and traceability of such continuously generated data remains a key challenge. Blockchain technology can complement sensor-based systems by providing a secure, distributed, and tamper-resistant platform for recording supply chain events and product histories. The integration of sensors and blockchain can therefore create connected, transparent, and traceable agri-food supply chains. At ICAR-CIPHET, a sensor-based system has been developed for monitoring temperature, relative humidity, and ethylene

during banana supply-chain operations, along with a Hyperledger-based blockchain framework for recording and tracing banana movement and supply-chain information. These technologies offer significant potential for developing future-ready and trustworthy agri-food supply chains.

Keywords: Agri-food supply chain; Sensors; Blockchain; Traceability; Real-time monitoring.

ICEMSET-2026/FS/INV/403

Numerical simulation and experimental validation of low frequency shear horizontal plate wave generation using EMAT

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Abstract

Electromagnetic acoustic transducers (EMATs) are advanced ultrasonic transducers widely used for non-contact and couplant-free inspection of electrically conductive metallic materials. EMATs can generate shear-horizontal (SH) plate waves, which offer significant potential for nondestructive testing of thin metallic components due to their in-plane particle motion, long-range propagation capability, and sensitivity to defects. This paper presents a numerical investigation and experimental validation of low-frequency SH plate-wave generation using a Lorentz-force-based EMAT. Three-dimensional numerical simulations were initially performed to investigate the frequency-dependent excitation characteristics and optimize the operating frequency for efficient generation of the fundamental SH0 mode in a 6-mm-thick stainless-steel plate. The spatial radiation pattern of the generated SH0 mode was analyzed in the sagittal plane, along with its directional displacement distribution. Subsequently, double-racetrack and elongated-spiral coil configurations, combined with an array of permanent magnets, were designed and fabricated for experimental SH-wave generation. The simulated time-domain waveforms and frequency spectra were systematically compared with experimental measurements. Good agreement was observed between the numerical predictions and experimental results. The generated low-frequency SH0 mode was further demonstrated for detecting artificial defects introduced into the 6-mm-thick stainless-steel plate, highlighting the potential of the developed EMAT configurations for thin-plate inspection.

Keywords: Electromagnetic acoustic transducers, Shear horizontal plate waves, Lorentz force, Double racetrack coil, Periodic permanent magnets, Time-frequency analysis.

ICEMSET-2026/FS/INV/404

Optimization of Video Compression Parameters Using Artificial Intelligence

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Abstract

The growing demand for high-quality video content across streaming, mobile, and real-time applications increased the computational complexity and energy consumption of modern video compression systems. Conventional video encoders rely on fixed or heuristically tuned parameters, which often result in sub-optimal performance for diverse video content. This paper presents an Artificial Intelligence (AI)-based approach for optimizing video compression parameters to improve coding efficiency while reducing computational overhead. Machine learning and deep learning models are employed to intelligently optimize key encoding parameters, including block partitioning, motion estimation, quantization, and rate–distortion control, based on content characteristics. The proposed framework enables adaptive and content-aware decision-making within the compression pipeline, thereby minimizing redundant computations without degrading visual quality. Objective evaluation using PSNR and SSIM confirms that the proposed AI-based optimization maintains competitive perceptual quality. The study highlights the effectiveness of AI-driven parameter optimization as a promising solution for efficient and sustainable next-generation multimedia compression systems.

Keywords: Video Compression, Artificial Intelligence, Optimization, Rate–Distortion Optimization.

ICEMSET-2026/FS/INV/405

Mixed-Matrix Membranes for Energy-Efficient Separation of Liquid Mixtures: Advances, Challenges and Perspectives

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Abstract

Separation of liquid mixtures remains energy-intensive by conventional distillation, motivating the development of selective membrane processes with lower thermal requirements. This work investigates polymer–filler interface engineering as a strategy for tailoring sorption, diffusion, and preferential water transport in mixed-matrix membranes (MMMs) for pervaporation-based dehydration. Polyether block amide (PEBA), ethyl cellulose (EC), and polystyrene (PS) were functionalized with nano-polyaniline (PANI) and zeolite 4A to modify membrane free volume, hydrophilicity, interfacial compatibility, and selective transport pathways. Their structure–performance relationships were evaluated for isopropanol–water, acetonitrile–water, and hydrazine–water separations, with emphasis on the influence of filler loading and dispersion on permeation flux and water selectivity. Extending the materials strategy toward circularity, biomass-derived carbon/PVA MMMs were developed through controlled dispersion, ultrasonication, and solution casting. Biomass-derived carbon promoted polymer–filler interactions and mechanical reinforcement, demonstrating the feasibility of converting renewable biomass resources into functional membrane constituents. The study establishes interface-controlled transport, nanofiller dispersion, and biomass valorization as complementary strategies for developing high-performance, resource-efficient membranes, offering a pathway toward low-energy azeotropic separation and circular membrane-materials engineering.

Keywords: Pervaporation, Mixed-matrix membranes, Polymer–filler interface, PANI, Zeolite 4A; Biomass-derived carbon; Circular economy; Sustainable membranes.

ICEMSET-2026/FS/INV/406

Photocatalytic hydrogen generation and its usage for hydrogenation of curcumin using WO_3 synthesized by green method

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Abstract

The selection of efficient photocatalyst capable of simultaneously addressing energy and environmental challenges is of significant interest. In this work, WO_3 nanoparticles has been synthesized using *Aloe Vera* extract and evaluated for photocatalytic hydrogen generation under visible light irradiation. Evolved Hydrogen was utilized for conversion of curcumin to tetrahydrocurcumin with superior medicinal properties. Structural, morphological, and optical properties were determined using different characterization techniques like XRD, FTIR, SEM-EDX, TEM, DRS and XPS. WO_3 nanoparticles demonstrated enhanced photocatalytic performance towards green hydrogen evolution.

Keywords: Nanoparticles; Photocatalytic; Curcumin; *Aloe vera*; hydrogen evolution.

ICEMSET-2026/FS/INV/407

Bio-Integrated Materials, Biotechnology & Biomedical Engineering

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Abstract

The convergence of bio-integrated materials, biotechnology, and biomedical engineering is redefining the development of next-generation healthcare technologies. This interdisciplinary field enables the design of

intelligent, biocompatible, and multifunctional systems capable of interacting dynamically with biological environments. Emerging materials, including biodegradable polymers, advanced hydrogels, nanostructured biomaterials, and bioactive scaffolds, are enabling significant advances in tissue regeneration, targeted drug delivery, biosensing, wound healing, and implantable medical devices. Integration with biotechnology further supports personalized medicine, regenerative therapies, organ-on-chip platforms, and real-time physiological monitoring. Despite these advances, challenges involving biocompatibility, immune responses, degradation control, scalability, reproducibility, and clinical translation remain significant. Addressing these challenges through multidisciplinary innovation can accelerate the transition from laboratory discoveries to clinically relevant solutions. This field therefore represents a powerful pathway toward precision healthcare, improved therapeutic outcomes, and sustainable biomedical technologies, with substantial potential to reshape future diagnosis, treatment, and regenerative medicine.

ICEMSET-2026/FS/INV/408

Quantum entanglement linking Earth's magnetic field with bird migration processes

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Abstract

Avian magnetoreception is the ability of birds to sense and react to the Earth's magnetic field that is estimated to be between 25 and 65 μT. It is believed that this sensory ability is very important for navigation, especially on migration. Recently, quantum effects (spin dynamics and quantum coherence) have been shown to be affected by the Earth's weak magnetic field strength and can lead to changes in reaction rates of biological systems. This suggests that birds can use the Earth's weak magnetic field to find their way around. A different quantum perspective is proposed: birds may use a light-sensitive molecule called cryptochrome to detect Earth's magnetic field through a radical-pair mechanism by quantum entanglement. When light enters a bird's eye, it can excite cryptochrome molecules with unpaired electrons. The spin of electrons form a radical pair. The quantum system is a two electrons radical pair, and each electron has spin quantum number one half. These two electrons can be in a singlet state or triplet state. These quantum phenomena can lead to changes in the reaction speeds of biological systems, suggesting a possible mechanism by which birds exploit the Earth's weak magnetic field for orientation and navigation. In this work, we investigate the entanglement properties of bipartite states formed qudits between birds and earth magnetic field, without spin-orbit interaction (SOI). L-S coupling, also known as Russell-Saunders coupling, is employed if SOI is absent.

Keywords: Avian magnetoreception, Quantum Entanglement, Earth's magnetic field, Earth's magnetic field.

ICEMSET-2026/FS/INV/409

Mild Activation assisted Solid State Process for CCTO based Ceramics: Phase Development, Morphology and its properties

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Abstract

Perovskite based materials are vital with potential applications as capacitors, varistors, optoelectronic and catalyst, energy devices. Calcium Copper Titanate (CCTO) based ceramics are important materials having perovskite structure with such potential applications with strong relation linking different routes and process parameters. In the present context, the formation of the CCTO electro-ceramic is carried out through agate mortar activation for a prolonged duration in order to induce strain; followed by annealing at 950°C for 24 hours. Phase development by XRD confirmed the required crystalline structure, crystallite size estimation about 26nm approximately, using the Scherrer´s equation followed by dislocation density calculation. Dense irregular patrticules are noted from SEM microstructure analysis followed by EDS mapping confirmed compound formation. The Particle size analysis by DLS reveals particulates from meso-scopic to sub-micron domain. Bonding analysis through the FTIR confirmed presence of the required M-O co-ordination providing support to

the XRD and in turn the compound formation. Tauc relation is used to obtain the band gap from the reflectance curve noted to be about 2.1eV(direct), 1.732eV(indirect) suggesting semiconducting nature of the material. PL spectra shows a sharp and intense luminescence in the visible region (maxima centered at 520nm), indicating possible application as semiconductors, LEDs and photocatalysts. Dielectric analysis in terms of dielectric constant and dielectric loss have been done and noted to be about 2688, 0.63 respectively at lower frequency region.

Keywords: Perovskite; PL spectra; Band gap; dielectric constant; dielectric loss.

ICEMSET-2026/FS/INV/410

Advanced Materials and Machine Learning for 5G and 6G Wireless Communication Systems

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Abstract

The development of 5G and upcoming 6G communication systems requires new materials and better antenna design methods for high-frequency applications. At millimeter-wave and sub-THz frequencies, the choice of substrate has a major effect on antenna performance. Materials such as Rogers RT/Duroid, RO4003C, RO4350B, polyimide, SiO_2, alumina, and PTFE are widely considered for high-frequency antenna design. Rogers substrates are suitable for low-loss mmWave antennas, while polyimide is useful for flexible and wearable applications. SiO_2 is commonly used in silicon-based devices, and ceramic substrates provide good thermal stability. New materials such as Graphene, GaN, GaAs, InP, and phase-change materials are also being explored for future communication systems. Metamaterials and metasurfaces can further improve control over electromagnetic waves and support reconfigurable antennas. Along with material development, Machine Learning (ML) is becoming useful in antenna design and optimization. ML techniques can predict parameters such as S11, gain, bandwidth, and resonant frequency with fewer electromagnetic simulations. Methods such as Gaussian Process Regression, Random Forest, and Gradient Boosting can be used for this purpose. For 5G, these approaches are particularly useful for 28 GHz mmWave antenna design, while future 6G systems are expected to operate at sub-THz and THz frequencies. The combination of suitable materials, antenna engineering, and ML can reduce design time and improve overall performance. This work highlights the growing role of advanced materials and machine learning in developing efficient, flexible, and reconfigurable 5G/6G wireless communication systems.

ICEMSET-2026/FS/INV/411

Bénard–Marangoni convection in a thermorheological dielectric fluid layer with non-uniform volumetric heating

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Abstract

The effects of non-uniform volumetric energy sources, temperature-dependent viscosity and surface-tension on Bénard–Marangoni–electrothermal-convection (BMETC) in an incompressible dielectric fluid layer are studied. The bottom surface is assumed to be rigid and isothermal, while the top surface is taken as a non-deformable, heat-free surface subject to a general Robin-type thermal boundary condition. The stability equations are solved as an eigenvalue problem using the Galerkin-technique under weighted residual method. The results indicate that viscosity and non-uniform volumetric energy source plays a significant role in BMETC. External radiation is a destabilizing factor while degree of heat transfer (larger values of Bi) from the dielectric fluid to the adjacent gas is a stabilizing factor in Bénard–Marangoni instability. The numerical results for the onset of BMETC were obtained in terms of the critical thermal Rayleigh number, electric Rayleigh number, and Marangoni number together with their corresponding critical wavenumbers as functions of the optical thickness. It is observed that as the optical thickness increases, the volumetric heat source becomes more localized near the

bottom of the layer, thereby intensifying the adverse temperature gradient. The results indicate that strengthening the non-uniform volumetric heat source accelerates the onset of ETC, while an increase in the Biot number and temperature dependent viscosity has a stabilizing effect, thereby delaying the onset of ETC. The validity of the method is established by comparison with the work in the literature for the case of the calculated values of optical thickness, internal heating rates and temperature-dependent viscosity parameter.

Keywords: Bénard–Marangoni convection; electrothermal instability; thermorheological fluids; volumetric internal heat, optical thickness; Robin boundary.

ICEMSET-2026/FS/INV/413

Groundwater Recharge Estimation using Artificial Neural Networks (ANNs) Techniques under limited data conditions: A Case Study of Check dam across Nandiyar Stream

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Abstract

Groundwater recharge estimation plays a critical role in sustainable water resource management, especially in semi-arid regions where water scarcity poses significant challenges. Traditional methods often face difficulties due to the complexity and nonlinearity of hydrological processes and data scarcity. This research study explores the development of groundwater recharge estimation models using advanced soft computing techniques, with a special focus on Artificial Neural Networks (ANN) and other machine learning approaches. The study highlights how these data-driven models can effectively capture the nonlinear dynamics of groundwater systems influenced by hydrological and environmental variables. The case study of the Kanakiliyanallur check dam constructed across the Nandiyar stream provides a practical context, illustrating how soft computing methods can enhance the accuracy of recharge estimations by integrating multifaceted data inputs such as rainfall, streamflow and soil characteristics. Furthermore, the review compares conventional and soft computing-based recharge estimation techniques, emphasizing the advantages of hybrid models for improving prediction reliability. The insights from this research paper underscore the potential of soft computing to support optimized groundwater management strategies, particularly in regions facing variable climate and anthropogenic pressures.

Keywords: Groundwater; recharge estimation; check dam; non-linear dynamics; Artificial Neural Networks (ANNs).

ICEMSET-2026/FS/INV/414

From Pixels to Intelligence: Deep Learning for Remote Sensing Image Processing

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Abstract

Remote sensing (RS) image represents massive earth observation data compressed in a single image. A single pixel in the image holds large area on earth with minute hidden details. Unwrapping the data and finding useful information from the image helps in application areas of multiple domain. The recent development in the Artificial Intelligence, especially Deep Learning (DL) helps explore RS image in a very efficient manner. The presentation highlights how the DL is useful in interpreting Satellite images. The session begins with the evolution of remote sensing images, then explains the transition from traditional feature-based methods, Machine Learning to Deep Learning. Also the presentation discusses about the application area of RS image

processing. To provide more guidelines to budding researchers the presentation also will discuss emerging research direction.

Keywords: Remote sensing image; Deep Learning; Feature based method; Machine Learning; Artificial Intelligence.

ICEMSET-2026/FS/INV/415

Innovative Teaching Strategies with AI-Powered Educational Tools

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Abstract

The rapid advancement of Artificial Intelligence (AI) is transforming the educational landscape by enabling innovative approaches to teaching, learning, and assessment. This invited talk explores the integration of AI-powered educational tools to create engaging, interactive, and learner-centered classroom environments. The session will demonstrate practical applications of digital platforms such as Kahoot, Claude, Curipod, AnswerGarden, Mentimeter, and other AI-enabled technologies that support active learning, formative assessment, content generation, collaborative learning, and personalized instruction. The talk will highlight effective pedagogical strategies for incorporating these tools into higher education classrooms, enabling educators to enhance student participation, improve learning outcomes, and streamline instructional processes. Real-world examples and live demonstrations will showcase how AI-driven technologies can facilitate instant feedback, adaptive learning experiences, creative content development, and data-informed teaching practices. The session is designed for faculty members, researchers, academic administrators, and educators interested in leveraging emerging AI technologies to foster innovation in teaching and learning. Participants will gain practical insights into selecting, implementing, and evaluating AI-powered educational tools to support modern educational practices and improve student engagement in both online and blended learning environments.

ICEMSET-2026/FS/INV/416

Effect of Guar-gum grafted Clay/Pomace based Composites loaded with Iron and Zinc on Thompson Seedless Grapes (Vitis vinifera *L.*)

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Abstract

Use of clay-polymer composites is the new avenue of research in the field of agriculture due to their role in controlled release of nutrients synchronizing with crop demand. Application of clay/pomace-based composites loaded with iron and zinc resulted in more grapes iron and zinc content. Iron content in grapes increased by 10.24% after application of guar-gum grafted pomace-polymer composite loaded with iron as compared to conventional iron fertilizer. However, the zinc content in grapes increased by 8.41% after application of Guar-gum grafted clay+pomace-polymer composite loaded with zinc as compared to conventional zincatic fertilizer. A significant increase in iron and zinc uptake was recorded in case of polymer composite treated soil. Hence, use of iron and zinc loaded guar-gum grafted clay/pomace-based composites emerged as a promising option for increasing iron and zinc content in grapes.

Keywords: Grapes; iron; zinc; composites; slow release.

ICEMSET-2026/FS/INV/417

Advancement in Photovoltaic Materials

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Abstract

The development of PV materials across three generations and examines the physics, engineering and sustainability issues that shape their future. The review starts from the photovoltaic effect and the properties of an ideal absorber. It then explains the Shockley–Queisser limit of about 33.7% for a single junction. First-generation crystalline silicon still supplies over 95% of global production. Its progress from Al-BSF to PERC, TOPCon, heterojunction, back-contact cells has been driven by better surface and contact passivation. Second-generation thin films (a-Si, CdTe, CIGS) use absorbers only 1 to 3 µm thick. CdTe and CIGS reach laboratory efficiencies of about 23%. III-V multi junction cells lead in efficiency, with 29.1% for single-junction GaAs and 47.6% under concentration. Halide perovskites are the most rapidly advancing material. Their tunable bandgap (about 1.2 to 2.3 eV), strong absorption and low-temperature solution processing have raised single-junction efficiency from 3.8% in 2009 to more than 27%.

Keywords: TOPCon, heterojunction, back-contact cells, thin-film solar cells, perovskite solar cells, tandem solar cells, Shockley–Queisser limit, stability, sustainability.

ICEMSET-2026/FS/INV/418

AI Smart Safety System for Industrial Workers

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Abstract

Factories and other industrial sites are risky places to work. Workers face heavy machines, poisonous gases, high heat, and unsafe behaviour. Even with strict safety rules, accidents still happen because of human mistakes, weak monitoring, and slow response. This paper presents an AI-based Smart Safety System that makes workplaces safer by watching continuously, spotting hazards, and sending alerts automatically. The system uses cameras, IoT sensors, machine learning, and real-time analysis to watch workers and their surroundings. It checks whether workers are wearing helmets, gloves, and vests. It also spots dangers such as fire, gas leaks, or a worker standing too close to a machine. When a rule is broken or a danger is found, workers and supervisors get an alert straight away. Unlike older systems, this system keeps learning from worker behaviour and past incidents, so its accuracy and response get better over time. Privacy is also respected: only safety-related data is stored. The results show fewer missed risks, faster response, and better rule-following. The system has strong potential for real industrial use.

Keywords: Artificial Intelligence, Industrial Safety, Computer Vision, IoT Sensors, Machine Learning, Worker Monitoring, Hazard Detection, Smart Systems.

ICEMSET-2026/FS/INV/419

Monte Carlo Simulation-Based Improvement of Thermoluminescence Dosimetry Accuracy of CaF_2:Dy for Therapeutic Proton Beam

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Abstract

Ion-beam therapy of localized cancers offers superior dose confinement and greater biological effectiveness than the conventional photon-beam radiotherapy. In radiation therapy, accurate assessment of radiation dose is critical for treatment planning, quality assurance and patient safety. Even though thermoluminescent dosimeters (TLDs) provide the most efficient passive dosimetry option for the low Linear Energy Transfer (LET) photon beams, for the high-LET ion beams, they do not offer such a reliable and accurate option primarily because of their significant LET-dependent dose response. Monte Carlo simulations (performed with FLUKA software) provided a dependable computational technique to calculate LET-dependent absorbed-dose energy-response correction factors for the TLD material CaF_2:Dy as a function of depth in water for proton beams of energies (in the range 80 – 280 MeV). It was found that the TLD material CaF_2:Dy could be used for accurate proton beam dosimetry provided its thermoluminescence response is corrected to account for its LET-dependency.

Keywords: Thermoluminescence dosimetry (TLD), Monte Carlo simulations (FLUKA), Ion-beam, Radiotherapy, LET.

ICEMSET-2026/FS/INV/420

Fabrication and Characterization of Chitosan–Sodium Alginate–*Abelmoschus Esculentus* Extract–Vitamin C–Lactic Acid Composite Membranes for Potential Skin Tissue Engineering

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Abstract

Synergistic biodegradable polymer systems offer potential for developing functional membranes for skin tissue engineering and wound healing. Methodology: Composite membranes were fabricated using solution casting with chitosan, sodium alginate, *Abelmoschus esculentus* (okra) extract, vitamin C (1 g), and lactic acid (1 mL). Glycerol (5 mL) and polyethylene glycol (PEG, 5 mL) were incorporated individually and in combination to improve membrane integrity. Six formulations were considered, including polymer blends and modified composites. Results and Discussion: Comparative characterization included Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), tensile strength, elongation at break, swelling behaviour, biodegradation, and in vitro biocompatibility. The evaluation examined the contributions of glycerol and PEG to membrane flexibility and structural integrity and the complementary roles of chitosan and sodium alginate in structural support and moisture retention. The complete formulation was assessed for its potential in wound-healing applications.

Keywords: Chitosan; Sodium alginate; *Abelmoschus esculentus*; Vitamin C; Composite membrane; Wound healing.

ICEMSET-2026/FS/INV/421

Development of a Rhodamine based Chemosensor for Targeted Detection of Toxic Metal Ions

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Abstract

The development of selective and sensitive chemosensors for identifying harmful metal ions have attracted significant interest due to its prospective uses in environmental surveillance and analytical assessment. Lead (Pb^{2+}) is a hazardous heavy metal, and its accurate identification is crucial for evaluating environmental pollution. In this scenario, a new pyranopyrazole-modified rhodamine B derivative (PR) was created as a dual-function colorimetric and fluorescent chemosensor for the specific detection of Pb^{2+} ions. The probe demonstrated a notable transition in colour from transparent to pink, and a considerable increase in fluorescence emission when interacting with Pb^{2+}. Spectroscopic analyses revealed a 1:1 binding ratio, characterised by a

binding constant of 1.523×10^4 M^{-1} and a detection limit (LOD) of 4.392 nM. The detection response was ascribed to the opening of the spirolactam ring generated by Pb^{2+}, corroborated by density functional theory (DFT) computations and single-crystal X-ray diffraction studies. Moreover, the sensing mechanism exhibited reversibility with the introduction of ethylenediaminetetraacetic acid (EDTA), indicating the feasibility of conducting multiple sensing procedures. The functional applicability of PR was additionally confirmed using visual identification employing test strips, solid-state sensors, and analytical recovery assessments in tap water and fruit juice specimens, yielding recoveries between 94.8% and 99.6%. Furthermore, the probe was utilised to develop molecular logic functions employing Pb^{2+} and EDTA as chemical inputs. These results position PR as a viable organic chemosensor for the selective detection of lead ions, with potential uses in environmental monitoring and the creation of portable sensing devices.

Keywords: Chemosensors; Lead; Pyranopyrazole; Rhodamine; Sensing device.

ICEMSET-2026/FS/INV/422

Luminescent calix[4]arene macrocycles bearing coumarin arms for liquid crystal, aggregation-induced emission, and bioimaging applications

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Abstract

This study presents a new approach for the synthesis of blue light-emitting macrocyclic compounds using the induction of functionalized coumarin with variable alkyl arms at the narrow edge of the calix[4]arene rigid core. All four macrocyclic compounds adopted cone conformation confirmed by ^{1}H NMR and DFT study. All four macrocycles exhibit nematic type liquid crystalline behavior with a broad temperature range. The structures of the macrocycles were confirmed by analytical and spectroscopy analysis. A detailed structure-property relationship reveals how the variations in terminal substituents affect the mesomorphic properties of the macrocycles with their temperature range and thermal stability. All four macrocycles exhibit good quantum yield with aggregation-induced emission behavior. Among the series, longer chain functionalized macrocycle was tested for nematode imaging study in both solution and aggregated state conditions. The results highlight calix[4]arene-functionalized coumarin frameworks with fluorescent liquid crystalline nature, attributed to their thermally stable mesophases and favorable optical properties, making them promising candidates for bioimaging applications.

Keywords: Calix[4]arene, coumarin, nematic, liquid crystal, macrocycle.

ICEMSET-2026/FS/INV/423

2D Photodetectors: The Flexible Frontier

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Abstract

Flexible optoelectronics have really taken off lately, mainly because they are lightweight, highly portable, and mechanically flexible. Today, researchers have access to a rich palette of 2D options for next-generation optoelectronics, including graphene, transition metal dichalcogenides, exfoliated gallium sulfide nanosheets, and 2D perovskite platelets. TMDCs which feature convenient band gaps around 1 to 2 eV provide a great alternative. For instance, tungsten disulfide (WS2) stands out with its high optical absorption coefficient and massive exciton binding energies of 700–800 meV. Beyond those, exfoliated GaS nanosheets show promise thanks to strong UV-visible absorption, while 2D perovskite platelets exhibit photoresponsivity and photoelectric behavior. More recently, antimonene has started making waves in flexible photodetectors for its solid responsivity and high on/off ratios, alongside black phosphorus, which remains a favorite for its high

mobility and tunable band gap. This discussion provides a comprehensive review of 2D materials specifically tailored for flexible photodetector applications.

Keywords: 2D materials, Graphene, transition metal dichalcogenides, Antimonene, Black Phosphorus, flexible photodetectors.

ICEMSET-2026/FS/INV/424

Intelligent, Circular Concrete Systems for Decarbonising Construction

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Abstract

The concrete industry faces a dual challenge: mitigating its substantial global carbon footprint while satisfying the structural demands of rapidly growing urban centres. Paper investigates the critical role of next-generation concrete materials in developing sustainable and smart built environments. Globally, traditional Ordinary Portland Cement (OPC) accounts for roughly 8% of greenhouse gas emissions, primarily driven by energy intensive clinker production. The integration of low-carbon supplementary cementitious materials (SCMs), geopolymer binders, and recycled aggregate systems offers a highly effective framework for decarbonising construction. By combining alternative binders with recycled construction waste, this approach establishes a circular economy that significantly reduces both industrial emissions and landfill dependencies. Through a combined analysis of life cycle assessments (LCA) and mechanical durability testing study demonstrates how eco efficient mixtures optimise material longevity, decrease maintenance overheads, and drastically curb embodied emissions. This research provides a holistic framework for implementing the intelligent, circular concrete systems essential to low-carbon infrastructure.

Keywords: Smart Concrete, Sustainable and Smart Built Environment, Embodied Carbon, Geopolymers, Circular Economy.

ICEMSET-2026/FS/INV/425

Metabolite-Based Self-Assembly: From Bioinspired Materials to Sustainable Technologies

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Abstract

Bioinspired nanotechnology has predominantly focused on complex biomolecular building blocks, including proteins, peptides, and nucleic acids. In contrast, the potential of simple metabolites as versatile building blocks for functional materials remains largely unexplored, despite their abundance in biological systems and their intrinsic capacity to self-assemble into ordered supramolecular architectures. Their structural simplicity, biocompatibility, natural abundance, and cost-effectiveness make metabolite-based materials promising candidates for developing sustainable and environmentally benign technologies. This lecture will explore recent advances in the emerging field of metabolite self-assembly, with a particular emphasis on its potential for designing functional supramolecular materials. Metabolite-derived architectures exhibit diverse physicochemical properties that can be harnessed for applications in mechanical reinforcement, optoelectronics, catalysis, piezoelectricity, and advanced nanomaterials. Drawing on our recent research, I will highlight the development of metabolite- and short peptide-based materials for environmental remediation, carbon dioxide capture and conversion, energy-related applications, and biomedicine. Particular attention will be given to how molecular structure, intermolecular interactions, and supramolecular organization can be exploited to tailor material properties and functions. The lecture will also discuss key challenges and emerging opportunities in translating these minimalist molecular systems into practical technologies. By bridging molecular self-assembly with sustainability-driven material design, metabolite-based systems offer a promising pathway toward next-generation solutions to pressing environmental, energy, and societal challenges.

ICEMSET-2026/FS/INV/428

Temperature and frequency dependence of dielectric behavior of lead-free BZT-BCT ceramics

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Abstract

We present the lead-free composite ceramics of perovskite type $0.5Ba(Zr_{0.2}Ti_{0.8})\ O_3$-$0.5(Ba_{0.7}Ca_{0.3})\ TiO_3$ (BCZT) made via solid-state reaction. The ceramic sample sintered at 1450 °C for 5 hours produced a very dense microstructure with a density of almost 95% of the theoretical density. At the morphotropic phase boundary (MPB), tetragonal and rhombohedral phases coexisted in a pure perovskite structure, according to the XRD study. The *P-E* hysteresis loop revealed a non-infinite resistance, which may support the lossy behavior of the ceramic sample. The ceramic sample reached a dielectric constant value (ε_r) of 540 and a tangent loss (Tanδ) of 1.0 at 500 °C. Over a frequency range of 1kHz to 1MHz, both the (ε and Tanδ) values drop with increasing frequency at various temperatures (25 °C- 500 °C). Different polarization techniques applied to a relaxor-type ferroelectric may be responsible for the unusual dielectric response.

Keywords: Ceramic sample, composite, relaxor, lossy, polarization; Mode of presentation: Oral.

ICEMSET-2026/FS/INV/429

Amorphous Carbon: An Emerging Material for Advanced Electronics

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Abstract

The excellent mechanical properties of monolayer amorphous carbon (a-C) thin film (an analog of monolayer graphene) with high deformation tolerance are expected to be useful for flexible electronics. I will talk about the fabrication of high-performance wafer-scale electronic devices both on flexible and solid substrates, exploiting the excellent properties of AC thin film. Firstly, I will discuss the unprecedented anisotropic conductivity of our synthesized hydrogenated amorphous carbon (a-C:H) thin film. Then I will discuss an unconventional conversion concept of transforming a rigid metal circuit into a foldable circuit. Since the synthesized a-C:H thin film has electrical transparency only in the vertical direction (anisotropic conductivity), the metal/a-C:H hybrid board reflects the complexity of the underlying metal circuit board. The a-C:H thin film electrically connects the cracked area of the metal line; thus, the hybrid circuit board is foldable without resistance change during repeated folding cycles. Then, I will discuss the remarkable performance of a-C:H thin film as an interfacial layer between gate dielectric and semiconductor in a thin film transistor device. Where the interfacial film a-C:H thin film reduces the interfacial trap state densities and increases the electronic mobility by 7 times and On/Off ratio by 3 times. A foldable perovskite light-emitting diode (PeLED) and a biaxially-stretchable alternating current electroluminescence (ACEL) display will also be discussed, which were fabricated using highly conductive transparent deformable Au film electrodes, synthesized utilizing a-C:H thin film. Finally, I will discuss the fabrication of a highly flexible pixelated ACEL display by a highly conducting pyrolyzed carbon (Py-C) ultrathin synthesized from a-C:H thin film directly on various target substrates.

Keywords: Amorphous carbon, Thin film, Facile synthesis, Protective layer, Flexible electronics.

ICEMSET-2026/FS/INV/430

Strategies for Strengthening Biosecurity in Indian Agriculture

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Abstract

India's agricultural biosecurity requires an integrated, systems-based approach combining prevention, surveillance, regulation, and farmer capacity-building to address risks from transboundary pests, diseases,

invasive species, and emerging technologies. Key priorities include strengthening quarantine infrastructure, diagnostic facilities, interagency coordination, and policy implementation across plant, animal, and allied agricultural sectors. Effective measures include improved border and post-border controls, comprehensive pest and disease databases, and robust early-warning and surveillance systems. At the farm level, biosecurity should emphasize restricted access, disinfection, quarantine, sanitation, proper waste management, and regular health monitoring. Farmer education, technical training, and improved access to resources are essential for wider adoption, particularly in dairy, poultry, and pig farming. Complementary approaches, including integrated pest management, biological control, digital decision-support tools, and agroecological practices, can reduce dependence on synthetic inputs and enhance agricultural resilience. Overall, strengthening agricultural biosecurity in India requires coordinated policy implementation, improved surveillance and diagnostic capabilities, and practical, affordable farm-level interventions. These measures are essential to protect agricultural productivity, safeguard animal and plant health, strengthen resilience against emerging threats, and support national food security and sustainability goals.

Keywords: Biosecurity, Pest and Disease Surveillance; Integrated Pest Management; Sustainable Agriculture.

ICEMSET-2026/FS/INV/431

Effect of hybrid nanoparticles on conjugate mixed convection of a viscoplastic fluid in a ventilated enclosure with wall mounted heated block

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Abstract

We consider the thermal performance due to mixed convection and conjugate heat transfer of a Al_2O_3-Cu/viscoplastic hybrid nanofluid in a ventilated enclosure. A cold viscoplastic hybrid nanofluid is injected through the inlet port placed at the lower left corner of the enclosure and an outlet is placed at lower right corner. A heated solid obstacle is mounted at the bottom wall of the enclosure and the left wall of the enclosure is considered to be uniformly heated. The viscoplastic nanofluid is modelled as the Casson fluid, in which the plastic viscosity is considered to be temperature dependent. Nanoparticles mass flux due to both Brownian and thermophoretic diffusion along with convection is taken into account. The Corcione model for the thermal conductivity and viscosity of the hybrid nanofluid is adopted. The presence of the heated obstacle at the lower wall induces a recirculating vortex above it, which reduces the heat transfer from the enclosure. This vortex disappears when higher range of Reynolds number is considered. Our results show that the inclusion of *Cu*-nanoparticles in the Al_2O_3-viscoplastic fluid manifests the heat transfer. The yield stress of the fluid reduces the heat transfer but enhances the entropy generation. The thermal performance of the system is evaluated by presenting the heat transfer to entropy generation ratio. An enhancement of the solid-to-fluid conductivity ratio intensifies the heat transfer as well as entropy generation. Hybrid nanofluid enhances both heat transfer as well as entropy generation with the rate of heat transfer higher than the rate of entropy generation. A comparison with the corresponding homogeneous model is provided to analyse the effect of slip velocity created by Brownian diffusion and thermophoresis of nanoparticles.

Keywords: Nanoparticles, Mixed Convection, Ventilated Enclosure, Nusselt Number, Entropy Generation.

ICEMSET-2026/FS/INV/433

Free-standing films of poly(vinyl alcohol) composites: structural, mechanical, and dielectric properties

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Abstract

Polyvinyl alcohol (PVA) is a biodegradable polymer with unique properties, making it ideal for producing various polymer composite materials. PVA has been combined with specific salts to fabricate metal (Ag)/metal

oxide (CuO, ZnO)@PVA free-standing nanocomposite films. These fabricated PVA-nanocomposite films show excellent flexibility, conductivity, and antimicrobial effects. Moreover, organic polar molecules are cross-linked within the PVA matrix to achieve simultaneous enhancement of dielectric constant, flexibility, and transparency by reducing the crystallinity of the polymer blend through proper selection of both polymer and additive of specific molecular weight. The incorporation of low molecular weight polar additives leads to a dielectric constant enhancement of approximately 3000-fold compared to the pure polymer at 1 Hz. The resulting films exhibit high optical transparency and excellent stretchability. Such flexible high-dielectric constant polymer blends have potential in energy storage, sensing, and dielectric applications due to their ease of fabrication and low cost.

Keywords: Poly(vinyl alcohol) (PVA); Polymer composites; Structure; Flexibility; Dielectric constants.

ICEMSET-2026/FS/INV/434

Development of Highly Efficient, Nonlinear Optical (NLO) Single Crystals: The Role of Physics in Making Devices

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Abstract

Gravity driven concentration gradient is used in the uniaxially solution-crystallization method of Sankaranarayanan-Ramasamy (SR). TGS, GPI, KAP, SSDH, DGZCD, DGBCM, benzophenone and many more crystals have been successfully grown by SR method. Longest benzophenone crystal having dimension of 1350 mm length and 55 mm diameter was grown for the first time in solution growth by SR method. Starting with a thin plate as seed a large size crystal can be grown. The physical properties and crystalline perfection of the SR method grown crystal is normally superior to the conventional method grown crystals. The quality of the SR method grown crystals has been improved by several modifications made in SR method. The impurity segregation cannot be avoided in the existing SR method. So we planned to introduce the RSR method for growing good quality, unidirectional single crystals. The effect of rotation on unidirectional crystal growth method (Rotational Sankaranarayanan - Ramasamy (RSR)) has been proposed for the first time. The organic nonlinear optical 2-Aminopyridinium 4-nitrophenolate 4-nitrophenol (2APNP) crystals have been grown by (i) conventional slow evaporation, (ii) Sankaranarayanan-Ramasamy (SR) method and Rotational SR (RSR) method. The grown 2APNP crystals were subjected to various studies like HRXRD, laser damage threshold, chemical etching, Vickers microhardness, birefringence, UV-Vis NIR, dielectrics and piezoelectrics. The Rotational Sankaranarayanan-Ramasamy (RSR) method grown crystals show excellent optical, mechanical, dielectric and piezoelectric behavior and higher laser damage threshold capability compared to the conventional and normal SR method grown crystals. HRXRD and etching studies showed that the quality of the RSR method grown crystal is better than conventional and normal SR method grown crystal. The Rotational Sankaranarayanan-Ramasamy (RSR) method can be used to grow single crystals along a specific crystallographic direction such as the phase matching direction in nonlinear optical (NLO) crystals. The unidirectional crystal growth method is ideally suited for crystal growth along this direction to obtain large size crystals required for obtaining SHG elements with minimum wastage. In addition, the unidirectional solution crystallization usually occurs at around room temperature; much lower thermal stress is expected in these crystals over those grown at high temperatures. Successful development of this unidirectional method will provide the technology to produce crystals at a yield close to 100% and easy scaling-up process.

ICEMSET-2026/FS/INV/435

Enhanced Ammonia and Ethanol Sensing through Adsorption-Mediated Interactions in Cellulose Nanofiber-Reinforced Modified ZSM-5 Nanocomposites

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Abstract

The present work reports the development of cellulose nanofiber (CNF)-reinforced modified nano-ZSM-5 composite sensors for the selective detection of ammonia and ethanol gases at low operating temperatures. The study investigates the role of CNF as a dispersing and reinforcing agent in enhancing the gas-sensing performance of modified nano-ZSM-5 zeolite matrices. Nano NaZSM-5 zeolites were synthesized and subsequently modified through dealumination and ion-exchange processes to improve their surface characteristics and adsorption properties. Flexible CNF/modified nano-ZSM-5 composite films were fabricated using a simple and cost-effective solution-casting technique. The structural, morphological, thermal, and surface properties of the developed composites were characterized using X-ray diffraction (XRD), Fourier transform infrared spectroscopy

Keywords: Cellulose nanofiber, ZSM-5, Nanocomposites, Gas sensor, Solution casting method.

ICEMSET-2026/FS/INV/436

Development of rice straw-based nanocellulose film and its application in food packaging

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Abstract

The Lignocellulosic biomass (LCB), like rice straw, is characterized by high carbohydrate content, low protein, and a composition of cellulose, hemicellulose, and lignin that can be valorised into a spectrum of innovative and sustainable products. Food packaging is a critically important area which is significantly impacted by the development of bio-nanocomposites. Nanocellulose extracted from rice straw possess remarkable properties such as biodegradability, low density, and exceptional mechanical and chemical properties, making it an ideal candidate for food packaging applications. In the present study, the rice straw variety under investigation revealed 72.7%and 52.4% holocellulose and cellulose components, respectively. The rice straw was subjected to three step chemical procedure (NaOH, Xylene and $NaClO_3$) to obtain high-purity cellulose free from hemicellulose, lignin, ash and extractives. The cellulose nanofibers (CCN) were prepared using high intensity ultrasonication. The prepared CCN were reinforced with plant-based extract to obtain bio-composite films and analysed for crystallinity, thermal stability, morphological features, and antimicrobial properties. The purity and crystallinity of the final produce was evaluated vis-à-vis pure cellulose.

Keywords: Lignocellulosic Biomass, Rice straw, Cellulose, Cellulose Nanofibres, Biocomposites.

ICEMSET-2026/FS/INV/437

Dual sensing of Cs(I) and HPO_4(II) in aqueous medium by urea based, imidazole coupled receptor with DFT investigations

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Abstract

The organic nanoparticles (ONP) of A of size 10-15 nm were produced by re-precipitation method in order to perform the sensing studies in aqueous medium. The characteristic fluorescence emission profile of 4-nitrophenyl isocyanate was observed for study of recognition behaviour of A towards different metal ions and anions. ONPs of A have shown selective recognition towards Cs(I) and HPO_4(II) in aqueous medium among several alkali, alkaline earth and transition metal ions as well as anions with limit of detection 2.24 µM and 2.06 µM for Cs(I) and HPO_4(II) respectively. The urea linkage provides flexibility and analyte binding site for A where urea backbone transfers its energy to metal ion. The ONPs of A have shown selective recognition behaviour towards HPO_4 (II) by two times enhancement in the fluorescence emission intensity at 363 and 440 nm via photoinduced electron transfer (PET) off mechanism.

Keywords: Fluorescence, Chemosensor, Urea, Cesium, imidazole, phosphate.

ICEMSET-2026/FS/INV/438

Comparative Evaluation of Farmyard Manure and Ghanjeevamrit as Components of Integrated Nutrient Management for Wheat Productivity and Soil Health

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Abstract

A field experiment was conducted during Rabi 2025-26 at the Soil Research Farm, CCS Haryana Agricultural University, Hisar, to evaluate FYM and Ghanjeevamrit as components of integrated nutrient management (INM) for improving wheat productivity and soil health. Compared with RDF alone (T2), INM comprising 150 kg N ha^{-1}, 30 kg P ha^{-1} and 15 t FYM ha^{-1} (T3) increased wheat grain yield by 12.5%, from 51.2 to 57.6 q ha^{-1}, and recorded the highest soil organic carbon (0.50%) and microbial biomass carbon (203.0 mg kg^{-1}). Increasing FYM from 5 (T4) to 10 t ha^{-1} (T5), alongside RDF, significantly increased grain yield from 52.5 to 55.3 q ha^{-1}. Similarly, increasing Ghanjeevamrit from 2.5 (T6) to 15 q ha^{-1} (T9) increased grain yield from 51.3 to 53.2 q ha^{-1}, with T9 significantly outperforming RDF. Reducing RDF to 75% with 15 q ha^{-1} Ghanjeevamrit (T10) did not maintain RDF-level yield. Overall, FYM-based INM was more effective for enhancing wheat productivity, while higher Ghanjeevamrit doses improved soil microbial biomass.

Keywords: Farmyard manure, Ghanjeevamrit, Integrated Nutrient Management, Soil Organic Carbon; Microbial Biomass Carbon; Nutrient Availability.

ICEMSET-2026/FS/INV/439

UAVs/Drones for Precision Irrigation: Innovative Technologies to Enhance Agricultural Productivity and Water Resource

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Abstract

Unmanned aerial vehicles (UAVs), commonly known as drones, offer an innovative technological solution for precision irrigation in agriculture, significantly improving water use efficiency and crop productivity. Equipped with advanced sensors, these drones collect detailed data on soil moisture, crop health, and environmental conditions, enabling farmers to irrigate only when needed. This precise water distribution reduces waste, mitigates the effects of climate change on agricultural resources, and promotes environmental sustainability. This research paper explores the capabilities of drone technology in managing water resources, monitoring crops, and providing real-time data to support informed agricultural decisions. In this research, a drone was used for the first time in Mosul city Nineveh Governorate in Iraq to monitor irrigation operations and manage water efficiently, as a project that can later be rolled out to all farmers. This case study classify agricultural fields based on irrigation quantity and relevant agricultural indicators. Two agricultural indices were used in the visible spectrum (TGI - Triangular Greenness Index and VARI - Visible Atmospherically Resistant Index). The study concludes that the use of drones for precision irrigation can significantly contribute to the development of smart and sustainable agriculture.

Keywords: Smart Farming; Remote Sensing; Crop Monitoring; Sustainable Agriculture; Water Efficiency.

ICEMSET-2026/FS/INV/440

Decision-Time Digital Twin Reasoning for Perishable Inventory Control: Evaluating Rollout Planning and Reinforcement Learning

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Abstract

Perishable grocery replenishment is complicated by volatile demand, limited shelf life, and category-dependent supplier uncertainty. Classical inventory policies provide interpretable decision rules, whereas reinforcement learning (RL) enables adaptation through experience; however, neither approach alone fully addresses these interacting challenges. This study introduces DC²T, a Decision-Centric Cognitive Digital Twin that applies decision-time rollout reasoning to perishable grocery replenishment. At each decision point, DC²T simulates candidate order quantities and selects the option with the best projected outcome. An RL recommendation, when available, is evaluated as one candidate rather than executed directly. Because public retail datasets lack the inventory, ordering, delivery, and expiration records required for this process, we develop the Stochastic Grocery Store Generator (SGSG) to reconstruct a plausible operational environment from sales data and assess it using five plausibility measures. Nine policies are evaluated in a Favorita-calibrated simulation: four classical policies, two independent RL implementations, and three decision-time reasoning configurations. Each RL policy is retrained with five independent seeds. Decision-time reasoning accounts for approximately 93.7% of the performance gap between the strongest classical baseline and the best configuration. Adding RL provides only a modest further improvement, while RL alone does not outperform the strongest classical policy. One RL implementation also performs consistently poorly for the category with the longest and most uncertain supplier lead time, indicating a possible delayed-credit-assignment limitation. Overall, decision-time rollout reasoning contributes more than RL alone to replenishment performance in the evaluated perishable, multi-supplier grocery setting.

Keywords: Digital Twin; decision-time reasoning; reinforcement learning; perishable inventory management; retail operations; rollout algorithms.

ICEMSET-2026/FS/INV/441

Scaling Distributed Corporate Infrastructures via AI-Native Architectures: An Empirical Framework for Adaptive Resource Allocation and Deterministic Compliance

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Abstract

As global enterprises scale digital operations within highly regulated markets, traditional cloud paradigms struggle with data fragmentation, computational overhead, and non-deterministic outputs from generative models. This paper presents an enterprise grade, AI-native architectural framework engineered to resolve these structural bottlenecks, utilizing empirical data from large scale deployments executed by Infi Tech World. Our approach integrates decentralized Retrieval-Augmented Generation (RAG) with localized vector sharding to enforce strict algorithmic determinism while reducing data latency by 40%. Furthermore, we introduce an automated multi-agent orchestrator that dynamically allocates computational loads across hybrid cloud environments, optimizing throughput during volatile transactional spikes. By grounding large language models (LLMs) in structured corporate knowledge graphs, this architecture enables secure, real-time decision making compliant with stringent domestic and international data protection standards (e.g., SOC 2 Type II, HIPAA). Empirical results validate that this framework improves operational efficiency by 35%, providing a robust, compliance driven blueprint for advanced enterprise AI adoption.

ICEMSET-2026/FS/INV/442

Synthesis and Characterization of Cobalt Oxide NPs using SapindusMukorossi (Soapnut) as natural surfactant, Possible Applications in Lithium – Ion Batteries, Supercapacitors, Sensors and in Mico Electronics

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Abstract

The synthesis of cobalt oxide nanoparticles has been carried out in the presence of sapindusmukorossi (Soapnut) as a surfactant and the characterisation of the synthesised nanoparticles has been carried out using analytical techniques such as XRD, magnetic studies and TEM. XRD studies shows cobalt oxide was formed as CoO and exhibit Face-Centered cubic closed structure. Size of metal oxide synthesized has been calculated by Scherer's formula and it has been observed that cobalt oxide has diameter ranging from 10 nm to 40 nm. Magnetic susceptibility measurements showed that there were no unpaired electrons in CoO. Hence, CoO is diamagnetic in nature. The exact size of the cobalt oxide was found using TEM. The size of the oxide was in the range from 28 nm to 50 nm. The synthesized Nanoparticles can be used in Lithium – Ion Batteries, Supercapacitors, Sensors and in Mico Electronics.

Keywords: Nanaomaterial, Cobalt oxide, TEM, Metal oxides, XRD analysis, Surfactant, mukorossi, Soapnut. Lithium – Ion Batteries, Supercapacitors, Sensors and in Mico Electronics.

ICEMSET-2026/FS/INV/443

MRI Brain Tumor Detection and Segmentation: Traditional Methods and Deep Learning Approaches

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Abstract

Precise identification and segmentation of brain tumors in magnetic resonance imaging (MRI) is of critical importance for diagnosis, treatment planning and longitudinal follow-up. The clinical reference standard is manual segmentation of subregions of the tumor by radiologists, which is time consuming, subjective and difficult to repeat for big datasets. In this paper a short survey is presented, which relates classical brain tumor detection methods based on image processing techniques (thresholding, watershed transformation, symmetry-based analysis and clustering) to recent deep learning methods based on convolutional neural network (CNN) techniques. Here, we evaluate preprocessing pipelines, key segmentation algorithms and common post-processing operations, and emphasize their strengths, limits and typical application scenarios in MRI. We also highlight practical issues such as unpredictability in tumor appearance, class imbalance, lack of annotated 3D datasets and the need for clinically interpretable models. Finally, we highlight open research avenues in robust multimodal MRI segmentation, uncertainty quantification, and the incorporation of automated techniques into computer-aided diagnosis pipelines.

Keywords: Brain tumor, MRI, Deep learning, Image segmentation, Convolutional neural networks, Computer aided diagnosis.

ICEMSET-2026/FS/INV/444

Spatial Distribution and Status of Soil Micro and Secondary Nutrients

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Abstract

In semi-arid regions, intensive cropping with fertilization focused mainly on N, P and K often depletes secondary and micronutrients over time. Soil samples from Jhajjar district were collected using Global Positioning System. Besides this, plant samples (10% of soil samples) were also collected. Results were evaluated against established critical limits to identify deficiencies and guide nutrient management. Mean available S, Zn, Fe, Mn, Cu and B were 111.5, 0.9, 14.3, 7.8, 0.8 and 1.6 mg kg^{-1}, respectively. Percent sample deficiency occurred in the order Zn (41.8%) > Mn (28.7%) > Fe (24.3%) > S (23.9%) > Cu (17.5%), while no sample was deficient in B. In plant samples, mean Ca, Mg and S were 0.08, 0.10 and 0.17% and mean Zn, Fe, Mn, Cu and B were 13.1, 353.4, 18.4, 5.6 and 49.7 mg kg. The findings provide a baseline for soil-test-based fertilizer recommendations, better nutrient-use efficiency and sustainable productivity.

Keywords: Soil, plant, micronutrients, secondary nutrients and fertilizer.

ICEMSET-2026/FS/INV/445

Herbicide-driven shifts in soil microbial dynamics under organic amendment management in pearl millet–wheat cropping system

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Abstract

Herbicide use can adversely affect soil microbial communities, nutrient cycling and soil health. A field experiment was conducted during 2022–2024 on Typic Haplustepts sandy loam soil at CCS Haryana Agricultural University, Hisar, to evaluate the combined effects of herbicide regimes and organic manures under pearl millet–wheat system. Treatments included three herbicide regimes, two application rates (recommended and 1.5× recommended dose) and four nutrient management practices in a split–split plot design. Herbicide application temporarily reduced microbial populations, microbial biomass carbon (MBC), microbial biomass nitrogen (MBN) and soil enzyme activities, but recovery occurred within 30 days. Integrated nutrient management increased dehydrogenase, alkaline phosphatase and urease activities by 28–60, 23–27 and 11–31%, respectively. Vermicompost recorded the highest microbial populations and increased MBC and MBN by 60 and 165%, respectively, over the control. Thus, organic manures, particularly vermicompost, effectively mitigated herbicide-induced microbial stress and sustained soil biological health.

Keywords: Herbicide, Soil Enzyme, Herbicide Regimes, Sewage Sludge and Vermicompost.

ICEMSET-2026/FS/INV/446

Sm^{3+}-Modified Zn–Mg Spinel Nanoferrites for Multifunctional Magnetic, Electronic and Environmental Applications

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Abstract

Rare-earth ion engineering provides an effective route for tailoring the functional response of spinel ferrites. In this study, $Zn_{0.9}Mg_{0.1}Sm_xFe_{2-x}O_4$ (x = 0.00–0.075) nanoferrites were synthesized by citrate-assisted sol–gel auto-combustion and investigated for multifunctional applications. X-ray diffraction confirmed the retention of the

cubic spinel structure, with the lattice parameter increasing from 8.4351 to 8.4497 Å and crystallite size from 33.46 to 41.66 nm. Microscopic and spectroscopic analyses supported the formation of crystalline nanoscale ferrites and characteristic metal–oxygen bonding. Sm^{3+} incorporation modified the electrical and optical responses, with band-gap energies of 1.78–1.93 eV. The saturation polarization reached 0.80 μC/cm², while soft magnetic behaviour was retained, with a maximum saturation magnetization of 2.192 emu/g and coercivity of 72.55 Oe. Under natural sunlight, the optimized composition achieved 81.72% Rhodamine B degradation within 150 min. These results demonstrate the potential of Sm^{3+}-modified Zn–Mg nanoferrites for multifunctional magnetic, electronic and environmental applications.

Keywords: Sm^{3+} modification; Spinel nanoferrites; Magnetic properties; Ferroelectric polarization; Functional materials.

ICEMSET-2026/FS/INV/447

Advanced Research Methodology: AI Tools, Systematic Literature Review, and Research Paper Writing for High-Impact Publications

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Abstract

This Faculty Development Programme (FDP) aims to enhance participants' understanding of advanced research methodology, effective research design, and contemporary tools and techniques for academic research. The programme will cover systematic literature reviews, identification of research gaps, formulation of research questions, and development of original research contributions. Special emphasis will be placed on the responsible application of Artificial Intelligence (AI) tools, data analysis, research validation, and the preparation of high-quality research publications. Participants will also explore research integrity, reproducibility, and open science practices. Through practical activities and hands-on exercises, the FDP will equip faculty members and researchers with essential skills to design methodologically sound studies, critically evaluate existing literature, analyse research findings, and communicate scholarly contributions effectively while maintaining ethical and transparent research practices.

ICEMSET-2026/FS/INV/450

Investigation of Structural, Dielectric and Impedance properties of Cu^{2+} and Er^{3+} co-doped $BaZr_{0.05}$ $Ti_{0.95\ 03}$ ceramics

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Abstract

The Bazro Tio9503 (BZT) material has been synthesized by solid-state reaction method and substituted by Cuo: Er2O3. The phase confirmation was done by using the X diffraction technique and Fourier transforms infrared spectroscopy. The microstructure analysis from the SEM suggested the reduction in grain size and density with increments in respective Er2O3 and CuO concentrations. The polarization versus electric field profile confirmed the increment in the value of remnant polarization with doping. Using impedance plots, electrical attributes are investigated as a function of frequency and temperature. The influence of bulk and grain boundary to the complex impedance was demonstrated by Nyquist plots. Jonscher's universal power law was used to study the behaviour of ac conductivity, and findings demonstrate that two types of conduction mechanisms i.e. non-overlapping small Polaron tunnelling model and the CBH model take place in the selected temperature range for all the samples. In contrast, the de conductivity is Arrhenius dependent.

Keywords: X-ray diffraction, Dielectric property, Impedance spectroscopy, Electric Modulus, Conductivity.

ICEMSET-2026/FS/INV/451

Magnetic and Optical properties of $Zn_{1-x}Al_xO$ ($0 \leq x \leq 0.12$) nanoparticles and their antibacterial activities

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Abstract

The sol-gel auto-combustion technique was used to synthesize $Zn_{1-x}Al_xO$ ($0 \leq x \leq 0.12$) nanoparticles. The XRD data show that there is only one phase with a hexagonal crystal structure. X-ray photoelectron spectra reveal that Al^{3+} ions exist in the doped specimen. Photoluminescence spectra exhibit various defects. The CIE chromaticity coordinates of the nanoparticles were calculated using the PL spectra. The correlated colour temperature (CCT) was calculated using the McCamy empirical formula, indicating that these nanoparticles are suitable for household optoelectronic devices. These nanoparticles exhibit diamagnetic behaviour at room temperature. An agar well diffusion technique was used to study the antibacterial activity. Aluminium doping was found to significantly increase the antibacterial efficacy of the ZnO nanoparticles.

ICEMSET-2026/FS/INV/452

Thermal energy upconversion using thermally-activated delayed fluorescence materials

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Abstract

Heat and thermal radiation are large components of energy provided by direct sun radiation, terrestrial radiation, byproducts of industrial and agricultural activity, physical, chemical and biological processes in nature as well. However, converting abundant thermal energy into electricity or mechanical work suffers from low efficiencies at modest temperatures, driving demand for novel conversion principles. Thermally activated delayed fluorescence (TADF) offers a compelling solution by upconverting heat into visible light, which can then power solar cells or provide direct lighting. This study demonstrates the potential of heat upconversion through the thermal management of TADF-based OLEDs, when heating to 50 °C near the turn-on voltage boosted their electroluminescence by 5–6 times, external quantum efficiency by up to 7.4 times, and power efficiency by 16%. Although high-temperature operation poses challenges for long-term device stability, overcoming these obstacles could enable efficient heat harvesting. Ultimately, managing emissions and energy upconversion in TADF-based OLEDs opens promising pathways for heat harvesting and energy-saving technologies.

Keywords: Thermal energy; Thermally activated delayed fluorescence; OLED; Energy upconversion.

ICEMSET-2026/FS/INV/453

Building Resilient Nile Water Infrastructure Through Integrated Engineering and Digital Risk Management in Ethiopia

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Abstract

The Nile Basin faces increasing challenges from reservoir sedimentation, watershed degradation, flooding, climate variability, and growing water, energy, and food demands. This study examines how digital technologies and integrated risk management can strengthen water infrastructure resilience in Ethiopia and support basin-wide cooperation. Evidence was synthesized from peer-reviewed literature, engineering assessments, and six Ethiopian case studies. Results indicate that Angereb Reservoir accumulated 2.18 million

m³ of sediment, Shumburit lost 7.52% of its storage capacity, and Koka experienced a 43.2% reduction. Watershed restoration reduced sediment yield in Gerda Catchment by 54%. High flood-risk zones covered approximately 35% of Ziway Watershed and 30.62% of the Wolaita study area. A hybrid AHP–Random Forest model achieved an AUC of 0.957. The study proposes an Integrated Engineering and Digital Resilience Framework integrating watershed management, infrastructure assessment, digital monitoring, forecasting, and adaptive decision-making to improve infrastructure sustainability and strengthen Nile Basin cooperation.

Keywords: Nile Basin; Infrastructure resilience; Reservoir sedimentation; Flood risk; Digital monitoring.

ICEMSET-2026/FS/INV/454

Multimodal Deep Learning for Early-Season Crop Yield Forecasting Using Satellite and Climate Data

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Abstract

Early and accurate crop yield forecasting is vital for food security and farm-level planning, yet single-source models struggle to capture crop–climate interactions early in the season. This study proposes a multimodal deep learning framework that integrates satellite imagery with climate data to forecast yield well before harvest. Vegetation indices from Sentinel-2 and MODIS are processed using convolutional neural networks, while temperature, rainfall, solar radiation, and humidity time series are modelled using Long Short-Term Memory networks. An attention-based fusion mechanism weights each data source across crop growth stages. The model is evaluated on historical field- and district-level yield records, with forecasts generated at multiple stages of the season, and compared against Random Forest, Support Vector Regression, and single-modality networks using RMSE, MAE, and R^2. The multimodal approach is expected to improve early-season accuracy and robustness, offering a scalable decision-support tool for farmers and policymakers.

Keywords: Crop yield forecasting; Multimodal deep learning; Satellite remote sensing; Climate data; LSTM.

ICEMSET-2026/FS/INV/455

AI Driven ciruit for EEG signal detection for brain tremours

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Abstract

Electroencephalography (EEG) is a non-invasive technique used to record the electrical activity of the human brain. Traditional EEG signal processing methods often face challenges due to noise, artifacts, and the complex nature of brain signals. This project proposes an Artificial Intelligence (AI)-driven circuit for efficient EEG signal acquisition, processing, and classification. The proposed system consists of EEG electrodes, a low-noise analog front-end circuit, signal conditioning and analog-to-digital conversion, a microcontroller, and an AI-based processing unit. The acquired EEG signals are filtered to reduce power-line interference and physiological artifacts before extracting relevant features. Machine learning or deep learning algorithms are then employed to identify patterns and classify brain activity. An integrated platform using an EEG acquisition IC, such as the ADS1299, along with a microcontroller and an AI-capable processor can support real-time signal analysis and visualization. The proposed system has potential applications in brain–computer interfaces, sleep monitoring, neurological research, and seizure-detection research. By combining electronic circuit design with intelligent signal processing, the system aims to improve automation, processing efficiency, and the interpretation of EEG signals. Further testing and clinical validation are required before the system can be used for medical diagnosis.

Keywords: Electroencephalography (EEG), Artificial Intelligence (AI), Signal Processing, Machine Learning, Deep Learning, Analog Front-End, ADS1299, Noise Filtering, Feature Extraction, Brain–Computer Interface (BCI), EEG Classification, Real-Time Monitoring.

ICEMSET-2026/FS/INV/456

Advances in Smart, Active, and Biobased Food Packaging: Integrating Biopolymers and Encapsulation Technologies for Sustainable Preservation

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Abstract

The modern food industry faces many issues, such as keeping food safe and fresh and mitigating the environmental impacts of harmful materials like Polystyrene Foam used in food packaging and through cups, which contain styrene; polyvinyl chloride (PVC)used for deli meat wraps, which uses phthalate plasticizers that cause health issues like hormonal imbalances, reproductive toxicity, and respiratory issues. This study evaluates next-generation food packaging architectures and the use of harmless materials for sustainable packaging, employing natural biopolymers and advanced encapsulation technologies to preserve food at a fundamental level. Active packaging preserves food quality through clear physicochemical and biocatalytic mechanisms like oxygen scavengers eliminate dissolved and headspace O_2 via chemical oxidation (e.g., iron auto-oxidation or enzymatic glucose oxidase catalysis), preventing Reactive Oxygen Species (ROS) formation, aerobic microbial proliferation, and enzymatic browning. To build these systems without synthetic plastics, researchers are turning to biobased polymers like chitosan, starch, and alginate. Chitosan is particularly valuable because it has a natural electrostatic charge that physically tears apart bacterial cell walls. Because natural materials can sometimes be fragile or sensitive to water, non-thermal processing methods like cold plasma and high-pressure processing that are applied to cross-link and strengthen their molecular structures without using damaging heat. To further enhance preservation, encapsulation technologies (such as nanoemulsions and liposomes) are utilized to protect sensitive, naturally derived antimicrobials like essential oils. By trapping these volatile compounds inside microscopic protective spheres, encapsulation prevents them from degrading upon exposure to light or oxygen and ensures a slow, steady release into the packaged food over time. Finally, the adoption of these innovations requires strict adherence to regulatory standards, ensuring that mass migration of any packaging compounds remains well below toxicological safety limits. By seamlessly integrating active defense mechanisms, strengthened biopolymers, and encapsulated release systems, this framework offers a highly effective, eco-friendly solution for the future of global food safety.

Keywords: Food Packaging; Biopolymers; Sustainable; Food Safety; Encapsulation Technology.

ICEMSET-2026/FS/INV/457

Emerging Technologies in Future Electronics: Innovations, Challenges, and Sustainable Applications

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Abstract

Emerging technologies are transforming electronics by enabling intelligent, energy-efficient, and sustainable solutions for modern engineering applications. This paper explores advancements in semiconductor devices, artificial intelligence, the Internet of Things (IoT), flexible electronics, and next-generation power electronic systems. Particular emphasis is placed on their potential to improve system performance, reduce energy consumption, enhance automation, and support renewable energy integration. The paper also highlights challenges related to electronic waste, device reliability, cybersecurity, thermal management, and sustainable materials. Applications in smart grids, electric vehicles, healthcare, and industrial automation are considered to identify promising directions for future research. The discussion underscores the importance of interdisciplinary innovation in developing reliable, intelligent, and environmentally responsible electronic systems that can meet evolving societal and industrial needs.

Keywords: Emerging Technologies; Future Electronics; Power Electronics; Artificial Intelligence; Internet of Things.

ICEMSET-2026/FS/INV/458

Monopole antennas for wireless communication applications

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Abstract

The Monopole antenna is one of the advanced antenna used to transmit and receive radio signals. This antenna is designed using dielectric substrates. One side of the dielectric substrate consists of radiating patch with feed line made from metal sheet and other side of the substrate having truncated ground plane. Planar broad band Monopole antennas have several benefits. There are different feeding technics are used. It as many advantages, such as small size, low weight and low cost, low profile, simple fabrication, & combination with other active devices. Various structures can be designed in monopole antennas. Such as square, circular, triangular etc. For different applications, we can design the antenna for single frequency, multi frequency or Ultra Wideband frequency range. The radiation pattern is the representation of the antenna's wave front emission or reception to specify its strength so that one can easily recognize the antenna's function & directivity. Monopole antennas finds applications in many fields. These can be used in biomedical imaging, Internet of Things (IoT) and intelligent wireless network systems. The development of ultra-wideband (UWB) technology using monopole antenna has been much concentrated for commercial use in the spectrum from 3.1 GHz to 10.6 GHz. By using slot method in the antenna, we can achieve UWB bandwidth. It is a good technology in a wide range of wireless applications such as short-range, high data transmission, multimedia, remote sensing etc.

ICEMSET-2026/FS/INV/459

Plasma-Assisted Semiconducting Carbon Nanostructures for Solar Cell Applications

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Abstract

Semiconducting Carbon Nanostructures (CNT & Graphene) Materials have shown great potential for Solar Cell applications due to their outstanding electrical characteristics. This research focuses on the modelling and simulation of a plasma-assisted semiconducting Carbon Nanotube & Graphene fabricated through the plasma-enhanced chemical vapor deposition (PECVD) process. A detailed analysis is conducted to evaluate how different plasma parameters influence the performance of the Solar Cells. The simulation results indicate that optimizing the thickness of absorber layer enhances the solar cell's functionality by increasing power conversion efficiency (PCE), Fill Factor (FF), Photocurrent density (J_{SC}), open circuit voltage (V_{oc}), Quantum efficiency (QE). These results emphasize the importance of precise plasma control in maximizing solar cell efficiency. The proposed semiconducting Carbon Nanotube & Graphene based solar cell design aligns strongly with experimental observations, confirming its feasibility for real-world Solar Cell applications. This study provides critical insights into the role of plasma-assisted fabrication in advancing semiconducting Carbon Nanotube & Graphene based solar cell technology for next-generation Photovoltaic (PV) Devices.

Keywords: Carbon Nanostructures, CNT & Graphene, Solar Cell, efficiency, Fill Factor, Photocurrent density (J_{SC}).

ICEMSET-2026/FS/INV/460

Eco-Safe Biopolymer Films for Controlled Release of Food Bioactives: pH-Responsive Anthocyanins and ZIF-8 Encapsulated Thyme Oil for Enhanced Fruit Preservation

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Abstract

Environmentally sustainable food-packaging films offer promising approaches for bioactive delivery and food preservation. In this study, a multifunctional pH-responsive film was developed using poly(vinyl alcohol)

(PVA) and chitosan (CS), incorporating red cabbage anthocyanins (RCA) and thyme essential oil encapsulated in ZIF-8 nanostructures (ZIF-8@TO). The resulting PCR/Z@T films exhibited antibacterial, antioxidant, UV-blocking, and pH-responsive properties. The optimized PCR/Z@T-1.6% film demonstrated antibacterial activity against Escherichia coli, Staphylococcus aureus, Bacillus subtilis, and Pseudomonas aeruginosa, with a tensile strength of 49 MPa, elongation at break of 39%, and radical-scavenging activity of 79.84%. The films also exhibited pH-dependent colour changes and soil-disintegration behaviour. During blueberry preservation at 25 °C, the optimized film delayed visible deterioration and decay for up to 10 days. These findings highlight the potential of the developed films as multifunctional active packaging materials with pH-responsive colour-changing capabilities for fresh blueberry preservation.

Keywords: ZIF-8, Thyme essential oil, Red cabbage anthocyanin, Biopolymer, Food packaging, pH-responsive film, Blueberry preservation.

ICEMSET-2026/FS/INV/462

Structural and Electronic Properties of Strained NbS_2 monolayer: A First-Principles Study

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Abstract

The first-principels calculations based on density functional theory are carried out to systematically investigate the structural and electronic properties of monolayer NbS_2 under the influence of applied biaxial strain. The calculations are performed using the plane-wave pseudopotential method implemented in the Quantum ESPRESSO package, employing the Perdew–Burke–Ernzerhof generalized gradient approximation (PBE-GGA) for the exchange–correlation functional. The optimized lattice parameters of monolayer NbS_2 are found to be in good agreement with previously reported theoretical results. The calculated electronic band structure and density of states indicate that unstrained monolayer NbS_2 exhibits metallic behavior. The study reveals that biaxial strains significantly influence the electronic band dispersion near the Fermi level, leading to modifications in the electronic properties of monolayer NbS_2. These findings highlight the potential of biaxial strain engineering for tuning the structural and electronic characteristics of NbS_2 monolayer.

Keywords: 2D systems, Electronic properties, Transition metal dichalcogenides, strain engineering.

ICEMSET-2026/FS/INV/463

Nonlinear Response of Elastic Wave Propagation in Polycrystalline Copper Using Fem

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Abstract

A 2D finite element numerical model is developed to study non-linear response of the elastic waves that passes through the boundary interfaces. An iso-parametric approach is used here to solve time dependent wave equation with the boundary and initial conditions. After obtaining system of discrete finite element matrix equations, an iterative solver with preconditioning is used. It is notified that the wave propagation is independent of the shape of the scattering object when the object size is much less than the wavelength. This idea is further motivated to model poly crystalline copper as a Voronoi network of cells in which each cell size much less than the wavelength. This is modeled as a 2D computational domain with the Hanning tone burst pulse as source of excitation. It is concluded that high and irregular scattering at the boundary interfaces of the poly crystalline copper. Also, it is concluded that anisotropic behavior is almost the same as the isotropic character when the grain size is very small.

Keywords: Anisotropy, cell size, orientation angle, iso parametric approach.

ICEMSET-2026/FS/INV/464

Dynamics of soil aggregate-associated Total organic carbon under the influence of varying nitrogen levels

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Abstract

Two field experiments were conducted during 2018-19 at UAS, GKVK, Bengaluru, to assess the effect of nitrogen levels on total organic carbon in aggregate size fractions under different crops. Treatments were laid out in a split-plot design, with three crops (finger millet, field bean and maize) as main plots and three nitrogen levels (high: 100% recommended dose [RD]; medium: 50% RD; low: no nitrogen) as subplots, under both rainfed and irrigated conditions. Soil was separated into macro-aggregates (>250 µm) and micro-aggregates (<250 µm) by wet sieving, and total organic carbon (TOC) in each fraction was determined using a TOC analyser. Under irrigation, increasing nitrogen levels enhanced TOC by approximately 25%, 37% and 16% in field bean, finger millet and maize soils, respectively, with the highest TOC under maize at the high nitrogen level (7.98 g kg^{-1}). Macro-aggregates accumulated more TOC than micro-aggregates; under rainfed conditions, TOC in macro-aggregates was higher than in micro-aggregates by 12.01%, 12.01% and 9.61% in field bean, finger millet and maize soils, respectively. The greater accumulation in macro-aggregates is likely due to the role of organic carbon as a binding agent for soil particles, which promotes aggregate formation and stabilises carbon within them

Keywords: Total organic carbon, Irrigated, Rainfed, Aggregates.

ICEMSET-2026/FS/INV/465

Effect of Preceding Crops, Tillage Practices and Moisture Regimes on Wheat Productivity under Conservation Agriculture

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Abstract

A field experiment was conducted during the *rabi* season of 2025–26 at Soil Research Farm, Department of Soil Science, CCS Haryana Agricultural University, Hisar, Haryana, to evaluate the effects of preceding crops, tillage practices and irrigation moisture regimes on wheat productivity. The experiment was laid out in a split-split plot design with three replications using wheat variety WH 1105. Wheat succeeding mungbean recorded higher grain (58.92 q/ha), straw (79.47 q/ha) and biological yields (138.39 q/ha) than wheat succeeding sorghum. Among tillage practices, zero tillage in both seasons (ZT–ZT) recorded the highest grain yield (59.64 q/ha), straw yield (79.31 q/ha) and biological yield (138.94 q/ha). Among moisture regimes, IW/CPE 0.90 recorded the highest grain yield (59.13 q/ha), biological yield (137.18 q/ha) and harvest index (43.2%). These results indicate the potential of mungbean preceding crops, zero tillage and appropriate irrigation scheduling for improving wheat productivity under Haryana conditions.

Keywords: Wheat, preceding crops, tillage, irrigation, yield.

ICEMSET-2026/FS/INV/467

Precision Mapping of Soil Properties Using SAR–Optical Data Synergy

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Abstract

Accurate mapping of soil moisture (SM), texture, and soil organic carbon (SOC) is essential for sustainable land management, yet their simultaneous prediction remains challenging. This study employed hybrid regression kriging (RK), combining random forest (RF) for deterministic prediction and ordinary kriging (OK) for spatially correlated residuals, to estimate SM, sand, silt, and SOC. A total of 246 soil samples were collected from West Bengal, India. Twenty-two predictors comprising Sentinel-1 and Sentinel-2 data, SAR indices, vegetation descriptors, terrain parameters, and weather variables were considered. Models were evaluated using an 80:20 training–testing split and independent blind validation. Compared with standalone RF, hybrid RF–OK-RK reduced RMSE for sand, silt, SM, and SOC by 16%, 16%, 11%, and 14% across the dataset. These findings demonstrate the potential of integrating multi-sensor, terrain, and weather data for concurrent soil property mapping across diverse land-use conditions.

Keywords: Soil Moisture, Soil Organic Carbon, Sand, Silt, SAR, Random Forest, Krigging.

ICEMSET-2026/FS/INV/468

Biogenic nanoparticles in Nematode Management: Advances, Challenges and Future Perspectives

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Abstract

Plant parasitic nematodes are considered as a “hidden enemy: of crop plants because these microscopic organisms cause direct damage to root system, disrupt nutrient, water uptake and predispose plants to bacterial and fungal infections. Because their symptoms often remain unnoticed during the early stage of infection, plant parasitic nematodes can cause recurrent yield loss with damage potential increasing over successive cropping seasons. Although conventional nematode management strategies can provide effective suppression, each method has inherent advantage and limitations. Chemical nematicides have traditionally been used for management of nematodes; however, their continuous and indiscriminate use in associated with environmental contamination, non – target toxicity, risk to human health, regulatory restrictions and the development of resistance. The limited availability of nematode resistant varieties/hybrids further constrains management options. Biological control agents offer promising alternative but their efficacy can vary considerable among locations because of environmental factors such as temperature, relative humidity, UV radiation and soil characteristics. This limitation s has stimulated increasing research interest in sustainable and environmentally compatible approaches for nematode management. Biogenic nanoparticle synthesis using plants, fungi, bacteria, algae and their bioactive metabolites represents a novel approach that integrates biological resources with nanotechnology. In plant mediated synthesis, phytochemicals act as reducing and stabilizing agent whereas in microbial system (fungi, bacteria, algae) enzymes, proteins and extracellular metabolites are being explored for nanoparticle synthesis and bioactivity. Silver, zinc oxide, copper oxide and other biogenic Nano materials have been investigated for their potential to manage nematodes. Their mechanism of action includes disruption of the nematode cuticle, induction of oxidative stress, impairment of cellular mechanism, reduction in egg hatching and interference with nematode infection, development and reproduction. In some studies, their application has also been associated with increase in plant growth parameter However, the biological activity and environmental safety of biogenic nanoparticles in soil depends on their composition, particle size, surface chemistry, concentration, stability, fate in soil environment. Major challenges include of variability in raw materials, lack of standardized synthesis and characterization protocols, limited field validation, production and scleup cost and potential risk to non-target organisms. Future research should therefore focus on standardized characterization, dose optimization, soil fate and exotoxicological assessment, multiplication field validation and regulatory frame work. The successful integration of biogenic nanoparticles into sustainable nematode management will depend on reproducible efficacy, demonstrated environmental compatibility and prove safety to non-target organisms under diverse agroecological conditions.

Keywords: Biogenic nanoparticles, plant parasitic nematodes, management, nanotechnology.

ICEMSET-2026/FS/INV/469

Novel Composite as Synthetic Bone Graft for Faster Bone Formation and Early Weight Bearing

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Abstract

Autologous bone grafting remains the gold standard for bone defects but is limited by donor-site morbidity, restricted graft availability, and surgical burden. Existing substitutes have limitations in osteogenic potential and mechanical compatibility. This study developed and preclinically evaluated a biodegradable synthetic cancellous bone graft designed to mimic cancellous bone architecture and support rapid regeneration and early weight bearing. Methods: Optimized fluorophosphate bioactive glass reinforced with osteogenic metal oxides was incorporated into a biodegradable polymer matrix to fabricate a porous scaffold. The scaffold was characterized by SEM and CLSM, evaluated for cytocompatibility, and assessed in two animal studies. Mechanical properties were determined according to ASTM standards and compared with native cancellous bone and commercial grafts. Results: The composite showed excellent biocompatibility, interconnected porosity, enhanced new bone formation, and mechanical properties closely matching native cancellous bone while exceeding commercial graft substitutes. Conclusion: The developed composite demonstrates potential for orthopedic bone reconstruction.

Keywords: Synthetic cancellous bone graft; Bone regeneration; Bioactive glass; Fluorophosphate; Biodegradable composite; Early weight bearing.

ICEMSET-2026/FS/INV/470

Grain boundary and substructure engineering for superior electrochemical corrosion resistance in ultra-low-Ni stainless steel

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Abstract

The present study investigates the effect of thermomechanical processing (TMP) on microstructural evolution and electrochemical corrosion resistance of ultra-low-Ni austenitic stainless steel (ASS). The steel was solution annealed at 1050 °C for 1 h, cold worked to 15%, 30%, and 50% reductions, and thermally aged at 900 °C for 2 h. XRD revealed progressive SIM formation during cold working and substantial martensitic reversion after ageing. EBSD analysis showed significant grain refinement through SIM reversion, recovery, and recrystallization, with grain size decreasing from ~100 μm to ~10 μm after 50% CW. The fraction and connectivity of low-Σ CSL boundaries also evolved with deformation. DLEPR and SEM analyses showed increased sensitization at 15% CW, whereas higher deformation substantially reduced DOS. Potentiodynamic polarization and EIS analyses confirmed that the 50% CW + TA condition yields noble shifts in corrosion potential and the largest capacitive arc radius (charge-transfer resistance), reflecting a continuous, protective passive film. The improved electrochemical resistance are attributed to the combined effects of SIM reversion, grain refinement, grain-boundary character and connectivity, deformation substructure, and precipitation behaviour.

ICEMSET-2026/FS/INV/471

Design of Graphene based Patch Antenna Structure for THz Applications

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Abstract

The advancement in VLSI and IoT technology has resulted in a boom in wireless devices and over crowding of EM spectrum. This has further resulted in the utilization of higher frequency spectrum for communication and

IoT devices. 6th Generation communication technologies utilize sub-terahertz frequencies (100–300 GHz) and miniaturized antenna structures. Graphene material is mainly utilized in THz antennas as it has better bending performance for flexible electronics, miniaturized footprint of structure and tunability to design reconfigurable antenna structures. Here the designing of non-conventional shaped patch antenna structure utilizing graphene will discussed.

Keywords: Graphene, Patch Antenna.

ICEMSET-2026/FS/INV/472

A Mutiscale heat transfer study of MXene nanofluids

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Abstract

In last few decades, MXene nano fluids show promising application in the field of domestic and industrial cooling. Motivated by the high impact of the same, in this multi-scale work, we have studied $Ti_3C_2T_x$ nano-sheets with PNIPAM polymer anchors interacting with water and Ethylene Glycol molecules. The Nano fluid after passing through Cu pipes, the calculated Cu(111)-MXene adsorption energy is observed to be (-1.380) eV, which suggests that MXene forms a microscopic thin layer inside the Cu pipe which acts as thermal bridge. This result in instant shooting of heat from Cu into the MXene layer and because of the high surface area, MXene transfers heat directly into the passing water molecules. The thermo-responsive phase transition of the PNIPAM polymer chains across their Lower Critical Solution Temperature ≈32∘C, which shows low aggregation dynamics. The calculated effective Thermal Conductivity and effective viscosity is observed as 0.785 W/m·K and 1.42 mPa·s respectively.

Keywords: MXene nano fluids, adsorption energy, Thermal conductivity, Lower Critical Solution Temperature.

ICEMSET-2026/FS/INV/473

Role of Critical Nanomaterials in Technology Innovation for Viksit Bharat 2047

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Abstract

Critical nanomaterials form the fundamental building blocks of India's deep technology industrial innovations a driving force for Viksit Bharat 2047.Achieving this ambitious goal requires leveraging the accelerating exponential technological change which is going to reshape and redefine the sectoral innovations and help them scale faster and smarter. Critical nanomaterial based emerging technologies need to be harnessed for fostering rapid industrial and sustainable economic growth. With technology growing at the unprecedented rates it becomes imperative to analyse how these critical nanomaterials will continue to evolve and disrupt technology in various sectors of the industry. Article enables understanding India's current capabilities, identifies gaps and bottlenecks and gives a roadmap to stimulate growth by innovations in the strategic sectors where these advanced materials are used. Semiconductor sovereignty, self-reliance in clean energy, sustainable agriculture and food security and advanced affordable healthcare are key focus areas for India's nanomaterial journey to Viksit Bharat 2047.We need to activate the crucial enablers like infrastructure, national policy missions, robust regulatory frameworks and venture capital for lab-based innovations to advanced commercial manufacturing.

Keywords: Critical Nanomaterials, Technology Innovation, Industry, Viksit Bharat, Policy.

ICEMSET-2026/FS/INV/474

Effect of Li_2O content on structural and optical properties of Li_2O-TeO_2-As_2O_3-B_2O_3 glasses

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Abstract

Arsenate-based alkali borotellurite glasses with the general formula xLi_2O-$(30- x)TeO_2$-$10A_2O_3$-$60B_2O_3$, where $5 \leq x \leq 25$, were formulated by the conventional melt quenching technique. The glassy nature of the samples was confirming by X-ray diffraction measurements. The influence of Li_2O content on the Fourier transform IR, optical, and thermal properties, density, and other related properties of the prepared glasses was studied. The results reveal that the density and molar volume decrease and the glass transition temperature increases with increasing Li_2O content This can be attributed to the difference in the ionic radii of lithium and tellurium oxides. The variation in the indirect optical bandgap and band tail with Li_2O content is discussed in relation to the glass structure. On the basis of the values obtained for o2- , the optical basicity, and the interaction parameter, the present glasses were termed normal ionic (basic) glasses. Fourier transform IR spectroscopy of the present glasses revealed that the borate network is affected by the replacement of TeO_2 by Li_2O. It was found that the fraction of four-coordinate boron atoms decreases and the fraction of three-coordinate boron atoms increases with increasing Li_2O content.

Keywords: Arsenate glasses, Density, Optical absorption, Basicity, Interaction parameters.

ICEMSET-2026/FS/INV/475

Electron paramagnetic resonance and optical properties of Cu^{2+} in PbO-Li_2O-As_2O_3-B_2O_3 glasses

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Abstract

The room temperature electron paramagnetic resonance (EPR) and optical absorption studies of PbO-Li_2O-As_2O_3-B_2O_3 glasses have been done by introducing a transition metal ion Cu^{2+} ion as a spin probe with fixed mole% in the given glass composition. Glasses containing transition metal (TM) ion give the information of site symmetry around the Cu^{2+} ion of the host glass. The EPR spectra of Cu^{2+} in all glass samples recorded in the X-band frequency (9.1–9.7 GHz) have similar features. The spin- Hamiltonian parameters have been calculated; the observed values are $g\| > g\perp > ge$ and $A\| > A\perp$. It suggests that the site symmetry around Cu+2 ion is tetragonal distorted octahedral and the ground state of Cu^{2+} is dx2-x2 ($^2B_{1g}$) orbital. The Cu^{2+} ion is coordinated with six ligand atoms in distorted octahedron site symmetry. The optical absorption spectra exhibit a broadband corresponding to d-d transition bonds of Cu^{2+} ion. Calculated bonding parameters suggest the covalent nature of in-plane σ-bonding (α^2) and pure ionic nature for out-of-plane (β^2) and in-plane π-bonding (12).

Keywords: Glasses, X-ray diffraction, EPR, Optical absorption, Cu^{2+} ion.

ICEMSET-2026/FS/INV/476

Comparative Study of 2D ZIF-L and 3D ZIF-67 for Adsorption-Based Wastewater Treatment

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Abstract

Metal-organic frameworks (MOFs) have emerged as promising materials for wastewater treatment owing to their tunable structures, high porosity, and potential for efficient pollutant adsorption. In this study, a

comparative investigation of two-dimensional (2D) ZIF-L and three-dimensional (3D) ZIF-67 was conducted to explore the influence of structural dimensionality on adsorption performance. The materials were synthesized using a solution-mixing method and characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), UV-visible spectroscopy, and Fourier-transform infrared (FTIR) spectroscopy to examine their crystalline structures, surface morphologies, optical properties, and functional groups. SEM analysis revealed leaf-like 2D structure for ZIF-L, and cubic 3D morphology for ZIF-67. The comparative adsorption of cationic and anionic dyes using synthesised materials revealed that 2D ZIF-L exhibited higher adsorption efficiency than 3D ZIF-67. The improved performance of ZIF-L may be attributed to greater accessibility of adsorption sites and enhanced interactions with pollutant molecules.

Keywords: ZIF-L, ZIF-67, Structural dimensionality, Adsorption, Wastewater treatment.

ICEMSET-2026/FS/INV/477

Smart and Sustainable: Active Biodegradable Edible Nanocomposite Packaging for Next-Generation livestock products Preservation

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Abstract

The modern food industry is facing major challenges to ensure food safety, maintain product quality and reduce environmental pollution from conventional plastic packaging. Milk, dairy products and other foods of animal origin are particularly vulnerable to microbial growth, enzymatic spoilage and lipid oxidation because of their high moisture content and nutrient-rich composition. Current packaging systems are not sustainable beyond providing physical protection, as most petroleum-based plastics remain in the environment. Therefore, the development of sustainable bio-based alternatives is required. The integration of food-grade biopolymers, bioactive compounds and functional nanomaterials into active biodegradable edible nanocomposite packaging is a promising approach to tackle these issues. Edible films made of polysaccharide, protein and lipid such as starch, chitosan, cellulose derivatives, alginate and carrageenan are promising substitutes for traditional packaging materials. Composite formulation and incorporation of plant-derived essential oils, natural antioxidants and judiciously selected nanomaterials may improve their functional performance. Essential oils can offer antimicrobial and antioxidant activities, and nanocomposite structures may improve the mechanical strength, barrier properties and functional stability of biopolymer-based films. These active packaging systems can inhibit spoilage microorganisms, retard oxidative deterioration, maintain sensory properties and extend the shelf life of perishable foods. The use of renewable biopolymers and suitable by-products from agro-industrial sources can also contribute to resource efficiency and circular design of materials. However, careful consideration must be given to the problems of formulation stability, sensory compatibility, migration, safety of nanomaterials, scalability, cost-effectiveness and end-of-life performance. Further research should focus on the use of food-grade ingredients, systematic safety assessment, standardized tests for biodegradability, and validation under real food-storage conditions. Overall, active biodegradable edible nanocomposite packaging provides a promising approach to safer food preservation, reduced dependence on conventional plastics, and development of sustainable packaging technologies in a circular bioeconomy.

Keywords: Active packaging; biodegradable edible films; nanocomposites; biopolymers; essential oils; food preservation; circular economy.

ICEMSET-2026/FS/INV/478

Engineering Charge Transport in Organic Thin-Film Transistors: From Hybrid Dielectrics to High-Mobility Electronics

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Abstract

Organic thin-film transistors (OTFTs) have attracted considerable attention for their potential applications in flexible electronics, wearable devices, sensors, and next-generation integrated circuits. Achieving high charge-carrier mobility while maintaining low operating voltage and device stability remains a major research challenge. This lecture highlights the evolution of OTFT technology in the recent past, emphasising advances in gate dielectric engineering, semiconductor–dielectric interfacial interactions, and molecular ordering. Particular attention is given to rare-earth metal oxide dielectrics, polymer–inorganic hybrid architectures, and emerging high-k dielectric systems that facilitate efficient charge transport. Recent developments in molecular engineering, interfacial trap suppression, and flexible device integration are discussed in relation to enhanced electrical performance. At the end, the lecture outlines emerging research opportunities and future strategies for developing high-mobility, energy-efficient, mechanically flexible, and operationally stable organic electronic devices.

Keywords: Organic thin-film transistors; Charge-carrier mobility; Hybrid gate dielectrics; Interface engineering; Flexible electronics.

ICEMSET-2026/FS/INV/479

Effect of Polymeric Interlayer on Electrical and Structural Characteristics of ZnPc-Based Schottky Diodes

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Abstract

Recently, the effect of ITO surface modification using polystyrene (PS) and poly(butyl methacrylate) (PBMA) interlayers on the electrical properties of zinc phthalocyanine (ZnPc) based Schottky diodes. Devices with Al/ZnPc/ITO, Al/ZnPc/PS/ITO, and Al/ZnPc/PBMA/ITO configurations were fabricated and characterized using I-V measurements. Polymer-modified devices showed higher rectification ratios, increasing from 0.81 for pristine ZnPc to 6.32 for PS and 4.24 for PBMA, along with improved ideality factors and lower series resistance. Space-charge-limited conduction became dominant in the modified devices. UV–Vis spectroscopy revealed reduced optical bandgaps from 3.05 eV to 2.75 eV (PS) and 2.68 eV (PBMA), indicating modified electronic interactions and molecular aggregation. X-ray reflectivity (XRR) and atomic force microscopy (AFM) further revealed structural modifications, including increased crystallite size and improved surface smoothness. These findings reveal that polymer interlayers effectively modify charge transport and enhance the electrical performance of ZnPc-based Schottky diodes, suggesting potential for optoelectronic applications. Detailed results of the study will be discussed at the conference.

Keywords: ZnPc, Schottky diode, ITO, Polymer modifications, Rectification ratio.

ICEMSET-2026/FS/INV/480

Digital Interventions for Tobacco Cessation

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Abstract

Tobacco use remains a major preventable cause of disease and premature death, while access to structured cessation support is uneven across populations. Digital interventions—including mobile health (mHealth) messaging, smartphone applications, tele-counselling, web-based programmes and virtual-reality approaches—may extend the reach of tobacco-cessation services beyond conventional face-to-face care. These tools can provide timely motivational messages, behavioural support, quit-date planning, craving-management strategies, follow-up and links to professional assistance. Their flexibility may be especially useful for people who face geographical, financial or time-related barriers to attending cessation clinics. However, outcomes depend on

intervention quality, sustained engagement, digital literacy, language accessibility, privacy safeguards and the availability of referral pathways for individuals who need more intensive support. Digital tools should therefore complement, rather than automatically replace, evidence-based counselling and appropriate pharmacotherapy. This presentation will discuss the potential applications of digital platforms in tobacco cessation, key implementation considerations and opportunities for integrating digital support into public-health and dental-care settings. A blended model combining digital follow-up with personalised professional counselling may help make cessation support more accessible, continuous and responsive to individual needs.

Keywords: Tobacco cessation; Digital health; Mobile health; Tele-counselling; Behavioural therapy.

ICEMSET-2026/FS/INV/483

X-Ray Diffraction Studies of ZnO, C Limon prepared by Green Synthesis

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Abstract

C. limon peel extract in deionized water was made using the methods outlined earlier (DOI: 10.5829/idosi.ijee.2014.05.03.10). Green synthesis of ZnO NPs were generated using a modified biogenic method (https://doi.org/10.1016/j.jclepro.2022.132242). An X-ray diffractometer (X'PERT PRO, Panalytical, Japan) was used to acquire an X-ray diffraction pattern across a 2θ region spanning 10° - 90°, which was then analyzed to determine the structural characteristics. It was found that *C. limon*-mediated ZnO crystallites averaged 71.93 nm in size, with the largest peak (101) measuring 59.29 nm. The other peaks observed in the XRD pattern were also identified using JCPDS card numbers and their corresponding interplanar distances. The peaks at 32.5274° (100), 37.0154° (101), and 48.2864° (102) confirmed the presence of ZnO crystallites with high crystallinity and purity. The peak at 57.3474° (110) indicated the presence of a small amount of $Zn(OH)_2$, which could be attributed to the incomplete conversion of $Zn(OAc)_2$ to ZnO during the synthesis process.

Keywords: ZnO NPs; Green Synthesis; X-Ray diffraction.

ICEMSET-2026/FS/INV/484

Perfusion Physics: Decoding Shock at Bedside

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Abstract

Shock is a life-threatening condition characterized by inadequate tissue perfusion and oxygen delivery. The biophysics of shock can be explained using the analogy of a tank, pump, and pipes, representing intravascular volume, the heart, and the vascular system, respectively. In hypovolemic shock, the tank is depleted; in cardiogenic shock, the pump fails; and in distributive shock, the pipes dilate, causing reduced systemic vascular resistance and relative hypovolemia. Obstructive shock occurs when blood flow is mechanically impeded despite adequate volume and potentially preserved cardiac contractility. These mechanisms may overlap, particularly in mixed shock states. Understanding this model helps clinicians interpret hemodynamic changes, recognize the underlying pathophysiology, and select appropriate interventions, including fluid resuscitation, vasopressors, inotropes, and relief of obstruction. This conceptual framework facilitates bedside assessment and rational, physiology-guided management of critically ill patients.

Keywords: Biophysics of shock; Hemodynamic physiology; Hypovolemic shock; Cardiogenic shock; Distributive shock.

ICEMSET-2026/FS/INV/485

Atomic Force Microscopy Analysis of Chitosan in Homoeopathic High-Dilution Cadmium Sulphuratum 1M: A Surface Topography Study AFM

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Abstract

Atomic force microscopy (AFM) is a high-resolution analytical technique used to investigate surface topography, nanoscale roughness, and height variations in material samples. Characterization of chitosan-containing preparations associated with homoeopathic high-dilution medicines may provide preliminary information about their surface morphology. To characterize the surface topography and roughness parameters of a chitosan-containing sample associated with Cadmium sulphuratum 1M using AFM. AFM topographic images were evaluated in two-dimensional and three-dimensional formats. Quantitative surface-profile parameters were obtained from the Z-axis forward data over a selected profile length of 9.92 µm. The measured parameters included average roughness (Ra), root mean square roughness (Rq), maximum roughness height (Rt), maximum valley depth (Rv), maximum peak height (Rp), skewness (Rsk), and kurtosis (Rku). The AFM roughness analysis demonstrated an average roughness (Ra) of 1.36 nm and a root mean square roughness (Rq) of 2.05 nm. The maximum roughness height (Rt) was 15.49 nm, with a maximum valley depth (Rv) of 11.09 nm and a maximum peak height (Rp) of 4.41 nm. The average maximum roughness height (Rtm) was 6.87 nm, while the average maximum profile height (Rz) was 6.42 nm. The negative skewness value (Rsk = −1.919) indicated an asymmetrical height distribution weighted towards valleys, whereas the kurtosis value (Rku = 12.239) indicated a sharply peaked distribution with pronounced height-profile extremes. The average wavelength of the profile was 0.81 µm. The maximum profile height (Pt) was 163.68 nm, reflecting the contribution of larger-scale height variations beyond the measured roughness component. AFM provided quantitative information on the nanoscale roughness and surface-profile characteristics of the analyzed sample. The low Ra and Rq values indicate relatively low average roughness along the selected profile, while the negative skewness and elevated kurtosis suggest localized valleys and pronounced profile extremes. These findings provide preliminary morphological characterization; however, attribution of the observed features specifically to chitosan or Cadmium sulphuratum 1M requires confirmation through sample-composition records, appropriate controls, and complementary analytical techniques.

Keywords: Atomic force microscopy; chitosan; Cadmium sulphuratum 1M; homoeopathic high dilution; surface topography; nanoscale roughness; AFM characterization.

ICEMSET-2026/FS/INV/487

Improving Glass Micro-Hole Drilling Performance with Emerging Hybridized Laser and Ultrasonic Assisted ECDM (L&UAECDM)

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Abstract

The need for better machining methods for glass microstructures used in micro-electromechanical systems (MEMS) is increasing due to the drawbacks of conventional Electrochemical Discharge Machining (ECDM), including poor surface finish, irregular hole geometry, limited hole depth, excessive taper, and thermal cracking. For glass micro-hole drilling, a hybrid method known as Laser and Ultrasonic Assisted ECDM (L&UAECDM) is suggested as a solution to these problems. While ultrasonic vibration enhances electrolyte circulation, discharge stability, and hydrodynamic conditions, laser heating raises the electrolyte temperature, stabilises the gas film, and encourages electrochemical reactions in LUAECDM. Surface roughness (SR), hole depth (HD), radial overcut (ROC), and crack formation are used to assess the machining performance. On a specially designed L&UAECDM setup, experiments are carried out utilising the one-factor-at-a-time (OFAT) approach. The machined micro-holes using hybrid method show superior circularity, increased dimensional precision, decreased heat damage, and increased material removal efficiency. L&UAECDM provides a promising method

for accurate and effective glass cutting in next-generation MEMS and other glass-based microfabrication applications by combining laser heating and ultrasonic vibration.

Keywords: Cracks; Surface finish; Overcut; Gas film; Laser assistance; Ultrasonic vibration; Dimensional accuracy.

ICEMSET-2026/FS/INV/488

Structural, Optical, and Dielectric Properties of $CoFe_2O_4$–$BaTiO_3$ Composite Materials

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Abstract

Cobalt ferrite ($CoFe_2O_4$, CFO)–barium titanate ($BaTiO_3$, BTO) composites have attracted interest because of their structural, optical, and dielectric properties, which may be useful in functional electronic materials. In the present study, CFO–BTO composite powders with different compositions were investigated. The samples were prepared using a solid-state method, and their structural properties were examined by X-ray diffraction (XRD). The crystallite size was estimated from the diffraction peaks using the Scherrer equation. The average crystallite sizes were calculated to be 23.496 nm for the 4CFO–6BTO composition and 20.921 nm for the 6CFO–4BTO composition. The optical properties were studied using UV–Visible spectroscopy, and the absorption spectra were used to evaluate the optical band gap. The dielectric properties were investigated using an LCR meter by measuring the dielectric constant and loss tangent as functions of frequency and temperature. The results indicated a decrease in the dielectric constant and loss tangent with increasing temperature under the investigated measurement conditions. These findings provide preliminary insight into the structure–property relationships of CFO–BTO composites and suggest their potential for further investigation in electronic and sensor-related applications.

Keywords: $CoFe_2O_4$; $BaTiO_3$; X-ray diffraction; crystallite size; UV–Visible spectroscopy; optical band gap; dielectric properties.

ICEMSET-2026/FS/INV/489

Bio-Integrated Protein Nanomaterials for Targeted Cancer Therapy: From Biological Function to Engineered Nanomedicine

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Abstract

The development of effective cancer therapeutics is challenged by inadequate tumor selectivity, inefficient intracellular drug delivery, and premature drug release. Bio-integrated nanomaterials that combine the intrinsic biological functionality of proteins offer an opportunity to address these limitations. Protein such as lactoferrin and transferrin are particularly attractive because of their biological relevance, biocompatibility, and potential for molecularly guided delivery. The objective mainly targets to highlight the significance of such proteins that can be engineered into multifunctional nanocarriers for target-specific delivery of cargoes. The particular includes key-findings of research work based on bioengineering of multifunctional proteins like lactoferrin and transferrin-based nanoparticles using desolvation approach, their systemic characterization, surface modification strategies, and evaluation through *in-vitro* and preclinical studies. Engineered protein nanocarriers demonstrated enhanced cellular uptake, sustained drug-release, improved anticancer efficacy, and superior tumor targeting. These bio-integrated nanomaterials represent a promising platform for precision cancer therapy with significant translational potential.

Keywords: Protein Nanoparticles; Lactoferrin; Transferrin; Targeted Drug Delivery; Cancer Nanomedicine; Bioengineering; Precision Oncology.

ICEMSET-2026/FS/INV/490

Molybdenum Disulfide (MoS_2) as a Multifunctional Nanomaterial: Emerging Applications in Sustainable Catalysis and Chemical Sensing

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Abstract

Molybdenum disulfide (MoS_2), a two-dimensional transition metal dichalcogenide, has emerged as a promising multifunctional nanomaterial owing to its unique structural, optical, electronic, and catalytic properties. Its tunable surface chemistry, abundant active sites, and visible-light responsiveness offer significant opportunities in sustainable chemistry and advanced sensing technologies. This presentation highlights the potential of MoS_2 in photocatalytic organic transformations, particularly the synthesis of biologically relevant heterocycles, and its applications in chemical and biosensing. Special emphasis is placed on visible-light-driven catalytic processes under environmentally benign conditions, as well as the development of MoS_2-based sensing platforms for detecting environmentally and biologically significant analytes. The role of nanomaterial properties, surface engineering, and structure–function relationships in determining catalytic and sensing performance will also be discussed. This overview aims to demonstrate how MoS_2-based materials can contribute to greener synthetic methodologies, environmental monitoring, and emerging healthcare technologies.

Keywords: MoS_2, two-dimensional nanomaterials, photocatalysis, green chemistry, chemical sensing, biosensing.

ICEMSET-2026/FS/INV/492

Thickness-Dependent SERS behavior of Sputtered Au-Ag Alloy Films Before and After Annealing

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Abstract

Sputtered metal films are an attractive route to SERS substrates because they need no lithography, and annealing is the usual way to refine them. Yet most annealing studies use a single, small film thickness, so how the same thermal step acts on films of different thickness is not well understood. Here we study co-sputtered Au-Ag alloy films on Si with thicknesses from 7 to 83 nm, before and after annealing in a inert environment. Surface-enhanced Raman scattering (SERS) of Rhodamine 6G serves as the probe, atomic force microscopy follows the film morphology, and finite-difference time-domain simulations help interpret the field behavior. As deposited, the SERS signal increases with film thickness. Annealing changes this in a thickness-dependent way: thin films remain active, whereas thicker films dewet into large mounds and lose most of their enhancement. These observations identify film thickness and thermal history as simple parameters for tuning SERS activity in alloy films, using only standard sputtering and annealing, with no lithography.

Keywords: Raman Scattering, Au-Ag alloy, Ion beam irradiation, R6G.

ICEMSET-2026/FS/INV/493

A Systematic Review of Biotelemetry Frameworks for Monitoring Real-Time Cardio-Respiratory and Thermoregulatory Physiology in Heat-Stressed Livestock

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Abstract

Climate-induced thermal stress threatens livestock welfare and metabolic efficiency. Traditional physiological monitoring often relies on manual, invasive sampling that introduces confounding stress artifacts. This

systematic review evaluates recent advancements in non-invasive biotelemetry frameworks designed to track real-time cardio-respiratory and thermoregulatory physiology in production animals. Analyzing twenty-five empirical studies, we assess wearable photoplethysmography sensors, subcutaneous microchips, and infrared thermography in monitoring heart rate variability, respiratory rate, and core temperature. Results show that automated telemetry detects autonomic shifts and heat-onset spikes up to 48 hours before clinical symptoms appear. We also examine current limitations, including sensor calibration, motion-induced noise, and battery life. Finally, we propose a conceptual framework integrating physiological telemetry with predictive edge-computing algorithms to enable proactive microclimate adjustments in smart barns, bridging veterinary physiology and precision agricultural engineering.

Keywords: Biotelemetry, Thermoregulation, Heat Stress, Precision Livestock Farming.

ICEMSET-2026/FS/INV/494

Computational Design and Optimization of Lead-Free $Cs_3Bi_2X_9$ (X = I, Br) Perovskite Solar Cells Using DFT and SCAPS-1D

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Abstract

Lead-free halide perovskites have gained interest in developing the materials sustainably needed for photovoltaics. This study explores $Cs_3Bi_2I_9$ and $Cs_3Bi_2Br_9$ with the help of the density functional theory (DFT) and simulation with the software named SCAPS-1D. The structural and electronic properties were calculated from BIOVIA Materials Studio, based on CASTEP. The lattice contraction and increase in band gap from 1.527 to 1.591 eV obtained were due to bromine substitution. The configuration of solar cells FTO/TiO_2/$Cs_3Bi_2X_9$/NiO/Au was simulated. $Cs_3Bi_2I_9$ demonstrated an efficiency of 12.73% and short circuit current density of 18.64 mA/cm² while $Cs_3Bi_2Br_9$ presented an open circuit voltage of 0.97V, a fill factor of 75.36% and efficiency of 13.03%. The two devices exhibited maximum simulated performance at a thickness of the absorber around 500 nm. Defect-density analysis was identified as an important aspect for reducing recombination losses. The results showed the potential bismuth-based perovskites as sustainable PV applications.

Keywords: Lead-free perovskites, Computational solar-cell design, Density functional theory, SCAPS-1D, Photovoltaic optimization, Sustainable energy materials.

ICEMSET-2026/FS/INV/495

A novel orange red emitting Sm^{3+}: $BaY(BO_3)_3$ phosphors for WLEDs

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Abstract

A series of $BaY(BO_3)_3 : xSm^{3+}$ (x=0.02, 0.04, 0.06 and 0.08 mol) phosphors were synthesized via conventional solid state reaction method. X-ray diffraction (XRD) confirms that all prepared samples are exhibiting a single-phase hexagonal structure with effective incorporation of Sm^{3+} ions. Under 402 nm excitation, the phosphor exhibits orange-red emission centered at 599 nm ($^4G_{5/2} \rightarrow {}^6H_{7/2}$), with the maximum intensity achieved at $x = 0.04$ mol. The critical energy transfer distance is approximately 24.59 Å, suggesting that the concentration quenching mechanism is dominated by dipole–dipole interactions. Meanwhile, the fluorescence lifetime decreases from 1.552µs, 0.752µs, 0.03199 µs and 0.000844µs with increasing Sm^{3+} concentration, owing to enhanced non-radiative interactions. The Commission Internationale de l'Éclairage (CIE) chromaticity analysis demonstrated high color purity (~86–88%) with stable orange-red emission and slight tunability, indicating suitability for warm light applications. These findings indicate that the $BaY(BO_3)_3$: Sm^{3+} is a promising orange-red phosphor for WLED applications.

Keywords: Borate Phosphors, Rare earth ion, WLEDs.

ICEMSET-2026/FS/INV/496

Green synthesis of gold nanoparticles using *Caesalpinia bonducella* leaf extract and their biological applications

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Abstract

The study describes a simple and green method for the synthesis of gold nanoparticles using the leaf extract of *Caesalpinia bonducella*. UV-Vis spectroscopy (UV-Vis), Fourier transforms infrared spectroscopy (FTIR), X-Ray diffraction (XRD) and Transmission electron microscopy (TEM) was used to characterize the gold nanoparticles. FTIR analysis indicates that - OH groups present in the leaf extract were responsible for the reduction of metal cations into nanoparticles. UV-Vis analysis showed a Surface Plasmon Resonance in the range of 518-538 nm due to the formation of gold nanoparticles. XRD studies indicated that the nanoparticles were crystalline in nature with face centred cubic geometry. TEM analysis revealed that the shape of the gold nanoparticles was in spherical forms and the average of particle size was 11±2 nm. In addition, the nanoparticles showed good antimicrobial activity against gram-positive and gram-negative bacterias. Thus, the study emphasizes that the green synthesized AuNPs could be considered as a promising antimicrobial agent.

Keywords: *Caesalpinia bonducella*; green synthesis; Gold nanoparticles; characterization; antimicrobial activity.

ICEMSET-2026/FS/INV/499

Investigation of Hydrogen Storage Capability of Osmium, Iron and Ruthenium Doped/Co-doped Graphene

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Abstract

Hydrogen energy is the most promising and counted as a perfect alternative fuel for ‘green’ energetics as it is plentiful element in nature. Hydrogen has 120 MJ/kg energy, which is higher in comparison to fossil fuels (44 MJ/kg for gasoline). Due to its characteristics hydrogen storage and transportation require additional safety measures. In present research, we thoroughly screen osmium, iron and ruthenium doped/co-doped graphene. Analysis of variation in various structural, electrical and thermodynamic properties of functionalized graphene before and after hydrogen adsorption has been done using density functional theory. The obtained findings indicate that co-doping of transition metal atoms improve the hydrogen storage capacity of graphene. The feasibility of doped graphene has been explored for hydrogen storage application by performing average Van’t Hoff desorption temperature calculations and with the help of ADMP simulations.

Keywords: DFT study, desorption temperature, Adsorption enthalpy, gibb’s free energy, ADMP simulations.

ICEMSET-2026/FS/INV/500

Smart Sensor Systems for Next-Generation Indoor Air Quality Management

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Abstract

Poor indoor air quality continues to threaten public health, since people spend the greater part of each day indoors breathing fine dust, allergens, and gaseous pollutants. Conventional filters, moreover, still perform poorly against ultrafine particles and reactive gases. Nanofiber- and nanofibril-based thin films and coatings, however, combine high specific surface area, tunable pore structure, and biocompatibility, and therefore capture

microscopic airborne contaminants efficiently. Transparent polyacrylonitrile films carrying photocatalytic coatings degrade gaseous pollutants under illumination, whereas soy-protein-derived films and fibers provide inexpensive, sustainable options that fit easily within hybrid filter architectures. When such coatings are paired with MEMS-based gas and particle sensors, machine-learning algorithms, and IoT connectivity, the resulting smart systems monitor pollutant levels continuously and tune their own operating parameters in real time. This convergence of functional thin films, distributed sensing, and intelligent control thus offers a promising route toward next-generation indoor environmental management and future advanced electronic sensing platforms.

Keywords: Indoor air quality; Nanomaterial thin films; Photocatalytic coatings; MEMS sensors; Smart air purification systems; Indoor air quality.

ICEMSET-2026/FS/INV/501

AI-Powered Early Fire Detection and Risk Assessment System Using IoT Sensor Networks

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Abstract

Early detection of fire risk is crucial to minimising damage to people, property, and natural resources. The majority of traditional fire detection systems rely on static threshold-based alerts, which occasionally don't respond until hazardous conditions have gotten worse, delaying responses and raising losses. In order to proactively identify risk escalation, this study suggests an explainable, AI-powered early fire risk detection method that makes use of temporal IoT sensor data. The proposed system integrates several sensor environmental inputs, including temperature, humidity, smoke concentration, and carbon monoxide levels, to assess fire threat in real time. By capturing shifting environmental dynamics through rolling window feature extraction and trend analysis, the methodology enables the identification of incremental risk accumulation prior to the emergence of critical conditions. By combining a machine learning-based risk classifier with a weighted risk rating system, a hybrid intelligence layer guarantees dependable and understandable decision-making in safety-critical scenarios. An early warning logic engine enhances the system by giving out signals when rapid risk escalation is observed, even before the classifier predicts a high-risk state. Explainability is integrated through risk attribution and feature contribution analysis, allowing users to understand the factors behind each decision. The suggested strategy successfully lowers fire incidences, according to an experimental analysis of IoT sensor data.

Keywords: Explainable artificial intelligence, Internet of Things (IoT), early warning systems, temporal feature analysis, and fire risk detection.

ICEMSET-2026/FS/INV/502

Hybrid Quantum–Classical Deep Learning for Multi-class Brain Tumor Detection from MRI Images

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Abstract

Brain cancer detection and classification from magnetic resonance imaging (MRI) remain challenging tasks in medical image analysis due to variations in tumor morphology, size, and structural characteristics. To address this challenge, this study proposes a hybrid quantum–classical deep learning framework for classifying brain MRI images into four categories: glioma, meningioma, pituitary tumor, and no tumor. We trained three convolutional neural network models, mainly ResNet18, DenseNet121 and EfficientNetB0. The classical networks are used for the future extractions, while these extracted features are projected into the quantum circuit using angle embedding, entangling layers and then used for the quantum feature transformation subsequently computing Pauli-Z measurements resulting in a final Quantum four class prediction. These were trained using

cross entropy loss and Adam optimizer with selected layers of pre-training and leaving remaining layers frozen. Among the three proposed hybrid quantum–classical models, Hybrid DenseNet121 achieved the best performance, with an overall accuracy of 94.44%, precision of 94.6%, recall of 94.4%, and F1-score of 94.3%. It also demonstrated strong class-wise discrimination, achieving ROC-AUC values of 0.97 for glioma, 0.99 for meningioma, 1.00 for no tumor, and 1.00 for pituitary tumor, and by this we can suggest that combining deep learning architecture with Quantum learning layer is effective for Brain tumor classification.

Keywords: Quantum computing, Quantum circuit simulator, Variational quantum circuit, Deep learning, Brain cancer detection, ResNet18, DenseNet-121 and EfficientNet, Multi class classification.

ICEMSET-2026/FS/INV/503

Accelerating Materials Discovery through Machine Learning and AI-based Data-Driven Modelling in Materials Science

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Abstract

Over the past decade, data-driven methodologies have established machine learning and artificial intelligence as a transformative fourth paradigm in materials research, effectively mitigating the high costs and time constraints of traditional trial-and-error experimentation. This overview explores how advanced AI-based modelling frameworks—ranging from supervised property prediction and graph neural networks to deep generative models—accelerate the screening, design, and optimization of novel materials across complex compositional spaces. We examine breakthroughs in atomic-scale simulation, where machine-learned interatomic potentials achieve quantum-level accuracy while bypassing the severe length- and time-scale limitations of traditional density functional theory. Finally, we highlight the critical integration of Explainable Artificial Intelligence (XAI) to bridge the gap between predictive performance and physical transparency, ensuring that data-driven materials discovery remains scientifically robust and interpretable, ensuring scientific transparency and trustworthiness.

Keywords: Machine Learning, Materials science, Data-driven modelling, Explainable Artificial Intelligence (XAI), Graph Neural Networks (GNNs), AI, Materials Discovery.

ICEMSET-2026/FS/INV/504

Tunable Optical Response and Surface Mode Excitation in Negative-Index Material Thin Films

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Abstract

This work presents an extensive theoretical investigation of electromagnetic surface modes supported by negative-index material (NIM) thin films through the attenuated total reflection (ATR) configuration. The study emphasizes on the excitation and propagation of surface modes under S-polarized incident light and their dependence on various physical parameters, including the angle of incidence, film thickness, and operating frequency. The reflectivity characteristics are analysed using the transfer matrix method (TMM), wherein the occurrence of distinct minima in the reflectivity spectra signifies the excitation of surface modes. Depending on their electromagnetic field distributions across the film interfaces, these modes are categorized into symmetric and antisymmetric branches. Their dispersion properties are subsequently determined from the corresponding resonance conditions, offering valuable insights into the coupling between incident electromagnetic radiation and surface-confined waves. The numerical results reveal that both the position and sharpness of the resonance dips are significantly influenced by variations in film thickness and operating frequency, demonstrating the possibility of tunable control over surface mode excitation. The investigation establishes that NIM thin films can

sustain well-defined surface modes that are effectively excited through the ATR technique highlighting potential applications in optical sensing, photonic devices, and advanced metamaterial-based optical systems.

Keywords: Surface Modes; Negative-Index Material (NIM); Attenuated Total Reflection (ATR); Transfer Matrix Method (TMM); Resonance.

ICEMSET-2026/FS/INV/505

Engineering Oxide Memristors: Defect Control to Neuromorphic Computing

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Abstract

Memristive systems are revolutionizing non-volatile memory, neuromorphic computing, and in-sensor edge processing. This talk presents a comprehensive device-to-system framework for oxide-based memristors fabricated via Dual Ion Beam Sputtering (DIBS). At the material and device level, we explore how tuning deposition temperature, oxygen partial pressure, and reactive electrode interfaces governs the transition between filamentary and homogeneous switching, as well as unipolar and bipolar modes across single and double Schottky barriers. We examine the critical impact of grain surface variations and nanoscale perturbations on switching uniformity, endurance, and forming-free operation. Bridging hardware to theory, we introduce threshold-independent analytical and 3D electro-thermal physical models that accurately capture filament kinetics and biological synaptic plasticity (LTP, STP, and learning behavior). Finally, we demonstrate a novel Y2O3-based transmission-gate memristor median filter at the sensor front-end, achieving high-speed, low-power denoising for X-ray, CT, and MRI biomedical imaging.

Keywords: Memristors, Dual Ion Beam Sputtering, Resistive Switching, Neuromorphic, computing.

ICEMSET-2026/FS/INV/506

Tailoring Phase Stability and Room-Temperature Multiferroic Performance in Sm-Substituted Bismuth Ferrite via Co–Cr Dual Doping

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Abstract

To mitigate electrical leakage and boost room-temperature multiferroic functionality, Bi0.88Sm0.12Fe0.88Co0.12-xCrxO3 ceramics (x=0.04,0.06,0.08,and 0.10) were synthesized using a chemical synthesis route. X-ray structural analysis reveals that the rhombohedral symmetry remains stable up to x = 0.08, beyond which a phase transformation into an orthorhombic lattice occurs at x = 0.10. Chromium substitution effectively relaxes internal compressive strain while driving an increase in average grain size. Robust Cr–O covalent bonding inhibits oxygen vacancy formation, resulting in a significant attenuation of leakage current. Among the series, the CR08 composition achieves the optimal balance of physical characteristics, yielding a maximum remnant polarization of 2.60 C/cm2. Spontaneous magnetization is likewise maximized in this composition owing to strengthened superexchange interactions and the collapse of the spin cycloid arrangement, which generates a net macroscopic magnetic moment. Additionally, a peak magnetodielectric response of 2.0 % is recorded at an applied magnetic field of 13 kOe. In contrast, the structural phase change in the CR10 sample leads to a deterioration across all multiferroic parameters. By balancing defect suppression with lattice strain relaxation, the CR08 formulation highlights a viable pathway for engineering room-temperature magnetoelectric devices.

Keywords: Bismuth ferrite; Multiferroics; Structural phase transition; Magnetodielectric effect; Co–Cr co-doping.

ICEMSET-2026/FS/INV/507

Pressure-Induced Structural Phase Transitions in Scandium-Based Ternary Borides: A First-Principles Study

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Abstract

First-principles calculations were performed to investigate the structural, electronic, magnetic, mechanical, and high-pressure properties of Sc_2AlB_6 and Sc_2CrB_6. Both compounds exhibit intriguing crystal structures comprising hexagonal, pentagonal, and heptagonal boron rings arranged in layers between metal atoms. Sc_2AlB_6 exhibits non-magnetic metallic behavior, whereas Sc_2CrB_6 displays ferromagnetism, primarily originating from Cr atoms. Bonding analyses reveal mixed covalent, ionic, and metallic characteristics in both the compounds. The electronic structure of Sc_2CrB_6 reveals spin-polarized band crossings near the Fermi level, suggesting Dirac-cone-like features. Elastic constants confirm the mechanical stability of Sc_2AlB_6 and Sc_2CrB_6. Under pressure, Sc_2AlB_6 exhibits no structural phase transition within the investigated range, while its predicted hardness increases. Conversely, Sc_2CrB_6 undergoes a pressure-induced transition from ferromagnetic to non-magnetic behavior at approximately 30.3 GPa.

Keywords: 2D materials; Pressure; Band structure; Elastic constants.

ICEMSET-2026/FS/INV/508

Electrochromic Materials: Advancing the Next Generation of Smart Devices

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Abstract

Electrochromic materials with tunable optical properties on application of small external voltage are being sought for a wide variety of next generation applications. Adaptive brightness in information display, glare-free automotive rear-view mirrors, sunroofs, smart windows in buildings and aircrafts, smart sunglasses are few examples where such materials have been put in vogue. In commercial market space, conventionally, Polymer Dispersed Liquid Crystals (PDLC) based smart glasses are being used which generally shows opaque and transparent coloration. However, electrochromic film coated smart glass has variable coloration, generally showing bluish and transparent coloration which can also be extended to muticoloration, depending on the choice of electrochromic materials. Further, electrochromic coating is a cost-effective facile process and has also the advantage of retrofitting. The electrochromic coating on glass can impact the Indian as well as the global market to a huge extent. The global smart glass market size is expected to expand at CAGR of 13.3% in 2030. The growing energy-conservation initiatives, such as green buildings and eco-friendly structures, and also the EC displays operating as the replacements for existing technologies like LCD, LED, e-link etc. are expected to drive the market expansion. Therefore, CSIR-CGCRI has taken an endeavour in this aspect on the indigenous development of smart electrochromic coating with advanced features which are almost coinciding with the globally bench marked materials. Till date a facile cost effective and easily scalable process technology of sol-gel dip coating has been utilized to prepare rGO modified WO_3 electrochromic thin films on glass which reveals a faster color switching kinetics of <2s and an immensely high coloration efficiency of ~ 386 cm^2/C has been achieved. A Two-electrode prototype assembly (10 cm X 10 cm) has been fabricated using indigenously fabricated free-standing solid electrolyte. Additionally, V_2O_5 based multicolored electrochromic materials have also developed with advanced electrochromic parameters.

Keywords: Electrochromism, Sol-gel Coating, Fast Kinetics, High Contrast, Smart Device.

ICEMSET-2026/FS/INV/509

Synthesis, Characterization of CNT/β-Ga_2O_3 Nanocomposite Sensor for Humidity-Assisted Ammonia Detection and its, Advanced wastewater treatment

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Abstract

Gallium oxide β-Ga_2O_3 nanorods were facilely prepared by a simple hydrothermal synthesis, and their morphology studied. The gallium oxide hydroxide (GaOOH) nanorods were formed in aqueous growth solution containing gallium nitrate and ammonium hydroxide at 95 °C of growth temperature. The physico-chemical properties were successfully characterized using From X-ray diffraction SEM, EDS, DLS analysis. The thermal behavior of the Ga_2O_3nanostucture was also investigated by differential thermal analysis, and their vibrational bands were identified by Fourier transform infrared spectroscopy. In order to examine the wastewater treatment by using electrochemical method, the degradation of dye and COD of wastewaterwas observed. As a result, the β -Ga_2O_3 exhibited high photodegeneration efficiencies with 98% and 92% of removal efficiencyrespectively, for 120 min of electrolysis time. Gallium oxide Ga_2O_3/CNTwas found to be a durable and stable during recycling, biocompatibility experiments. The development of CNT with functionalized bunches on the outside of was investigated by XRD, XPS, EDS, TEM, the normal size of β-Ga_2O_3/CNT was around 8.26 nm with uniform size appropriation. Drop casting method was used to prepare the sensor electrode on silver IDE. Sensing of NH_3 was performed under different humidity conditions. The results revealed that the sensor composite with 5 wt.% Gd_2O_3 and 95 wt.% Ga_2O_3 exhibits highest response of 300% with quick response and recovery time under room temperature at 69% of relative humidity. In addition to the chemical and electrical sensitization effects, the sensing mechanism mediated by the adsorbed humidity and oxygen on the surface of the sensing material is responsible for the improved NH_3 sensing at ambient temperature.

Keywords: Gallium oxides; Nanostructures; hydrothermal synthesis; electrochemical method, Gas Sensor.

ICEMSET-2026/FS/INV/510

Sustainable Water Hyacinth–PVA/Nanographene Biopolymer for Flexible Electronic Sensing Applications

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Abstract

The development of sustainable electronic materials from waste biomass offers promising opportunities for next-generation flexible sensing technologies. In this study, invasive aquatic weed *Eichhornia crassipes* (water hyacinth-WH) is valorized into a biodegradable polymer nanocomposite film for sweat chloride monitoring. Mercerized WH is incorporated into a polyvinyl alcohol with nanographene through simple solution-casting process. The developed film exhibits promising electrical conductivity, flexibility, biodegradability and biocompatibility, making it suitable for sweat sensor applications. Electrical measurements demonstrate distinct variations in sensor response upon exposure to artificial sweat containing different chloride concentrations. This concentration-dependent electrical response highlights film's potential for monitoring sweat electrolyte variations. Since elevated sweat chloride concentration is an important biochemical indicator associated with cystic fibrosis (CF), the developed material presents potential for integration into low-cost, flexible and wearable platforms for preliminary CF screening. This work integrates biomass valorization, nanocomposite engineering and sustainable electronic sensing aligning with the UN sustainable development goals.

Keywords: Biopolymer; Wearable sweat sensor; Cystic fibrosis; Water hyacinth; Graphene.

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ICEMSET-2026/FS/INV/511

Study on photocatalytic and antibacterial properties of phase pure Fe_2O_3 nanostructures synthesized using Phyllanthus niruri and Moringa stenopetala leaves

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Abstract

The synthesis of phase pure Fe_2O_3 nanoclusters using Phyllanthus niruri and Moringa stenopetala leaf extract as reducing and stabilizing agents. The structure and physicochemical property of the nanoparticles are characterized by X-Ray diffraction (XRD), Fourier Transform Infrared Spectroscopy (FT-IR), Ultraviolet Diffuse Reflectance Spectroscopy (UV-DRS), Field Emission Scanning Electron Microscopy (FESEM) and High-Resolution Transmission Electron Microscopy (HRTEM) analysis. The HRTEM results reveals that the particle size of C. Fimbriata and A. Aspera treated Fe_2O_3 nanoparticles were found to be ∼25 nm and ∼22 nm, respectively. The photocatalytic degradation and reusable of the green treated Fe_2O_3 Nanoparticles were performed by the photodegradation of Methylene Blue (MB) dye solution under solar light irradiation. In addition, green synthesized Fe_2O_3 nanoparticles assayed against gram-negative bacteria Escherichia coli (E.coli)

ICEMSET-2026/FS/INV/512

Electrical characterization of pulsed laser-deposited *n*-$CdIn_2Se_4$

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Abstract

In the present investigation, $CdIn_2Se_4$ thin films were pulsed laser-deposited on *p*-Si. The crystal structure of $CdIn_2Se_4$ thin films was examined by GI-XRD, evidencing sharp and intense (111) and (113) characteristic reflections confirming polycrystalline growth of $CdIn_2Se_4$ thin films, which is in good agreement with the ICDD 00-076-0692 for tetragonal (pseudo-cubic) α-$CdIn_2Se_4$ (space group P-42m (111)). The surface morphology of the $CdIn_2Se_4$ thin films, as observed by SEM. The dark voltage-current characterization confirms the formation of a typical diode-type junction between *n*-$CdIn_2Se_4$ and *p*-Si. The voltage-capacitance characterization extracted the zero-bias built-in diffusion potential, donor impurity concentration, depletion width, and flat-band barrier height for the abrupt *n*-$CdIn_2Se_4$/*p*-Si heterojunction. Based on Anderson's model, various electrical transport parameters have been used to plot the theoretical energy band diagram for an *n*-$CdIn_2Se_4$/*p*-Si type-I anisotropic heterostructure. FTIR provided information on the functional group/s (if any) extant in the $CdIn_2Se_4$ thin films. The implications are discussed.

Keywords: $CdIn_2Se_4$; Heterojunction diode device; Electrical characterization; Energy band diagram.

ICEMSET-2026/FS/INV/513

Parametric Analysis of Abrasive Wear Behaviour of Graphite filled Carbon Epoxy Composites

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Abstract

This study investigates the abrasive wear behaviour of carbon fibre-reinforced epoxy composites filled with graphite particles. Experimental investigations were conducted using an abrasive wear testing rig to evaluate the weight loss of the composite specimens under different normal loads and sliding distances, considering varying weight fractions of graphite filler. The Taguchi method was employed to investigate the influence of process parameters on the abrasive wear behaviour of the composites. Multiple regression analysis was performed to develop a mathematical relationship between weight loss and the selected process parameters. The results revealed that the weight loss increased with an increase in normal load, sliding distance, and graphite filler content. Finally, confirmation experiments were conducted to validate the experimental findings and the predictive capability of the developed regression model.

Keywords: Carbon epoxy composite; Graphite filler; Abrasive wear; Taguchi method; Multiple regression analysis.

ICEMSET-2026/FS/INV/515

Nanocomposite Materials: From Fundamental Properties to Practical Applications

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Abstract

The growing demand for advanced materials with multiple functional capabilities has stimulated extensive research into the development of hybrid nanostructures with tailored physical and chemical properties. In this context, the combination of magnetic nanoparticles with two-dimensional (2D) materials, such as graphene (G), graphene oxide (GO), and reduced graphene oxide (RGO), has emerged as a promising approach for designing multifunctional nanocomposites. The synergistic interaction between these components provides opportunities to enhance electrical conductivity, magnetic response, structural stability, and interfacial charge-transfer characteristics. These hybrid systems can be fabricated using facile synthesis techniques, including hydrothermal and co-precipitation methods, while swift heavy ion irradiation offers an additional route for engineering their structural, electrical, and magnetic properties through controlled defect generation. Beyond graphene-based systems, transition metal dichalcogenides (TMDCs), particularly MoS_2 and WS_2, have attracted significant interest as versatile 2D materials because of their distinctive optical characteristics, tunable band structures, and thickness-dependent electronic properties. Integrating TMDCs with carbon-based magnetic nanocomposites can provide additional control over electronic interactions and Raman signal enhancement, thereby improving their potential for surface-enhanced Raman scattering (SERS)-based molecular detection. Moreover, the incorporation of magnetic components facilitates rapid separation and recovery of the nanocomposites, offering advantages for environmental remediation and sensing applications. Such multifunctional hybrid architectures hold considerable potential for efficient water purification, trace-level detection of environmental pollutants, and emerging energy and electronic technologies.

Keywords: Multifunctional Nanocomposites; Magnetic Nanoparticles; Transition Metal Dichalcogenides; Swift Heavy Ion Irradiation and Surface-Enhanced Raman Scattering.

ICEMSET-2026/FS/INV/516

Beyond Diagnosis to Therapy: Integrating Microwave Imaging and Hyperthermia for Next-Generation Biomedical Applications

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Abstract

The convergence of microwave imaging and microwave hyperthermia is emerging as a promising frontier in biomedical engineering, offering new possibilities for non-invasive disease detection, targeted treatment, and personalized healthcare. Traditionally, microwave imaging and hyperthermia have been explored as independent technologies, serving diagnostic and therapeutic purposes, respectively. However, their integration presents an exciting opportunity to develop intelligent healthcare systems that can not only identify abnormal tissue characteristics but also deliver controlled therapeutic heating based on the detected information. Microwave imaging utilizes the dielectric properties of biological tissues, particularly variations in permittivity and conductivity, to identify abnormalities and distinguish between healthy and diseased tissues. Its non-ionizing nature, potential for low-cost implementation, and non-invasive operation make it an attractive alternative or complementary approach to conventional imaging techniques. On the other hand, microwave hyperthermia employs controlled electromagnetic energy to elevate the temperature of targeted tissues, typically within the therapeutic range of 40–45°C, thereby enhancing the effectiveness of cancer treatments such as radiotherapy and chemotherapy. The real technological breakthrough lies in establishing a closed-loop relationship between these two approaches. Microwave imaging can provide information about tissue properties and treatment regions, which can guide hyperthermia energy delivery. Subsequently, imaging-based monitoring can help assess temperature-related tissue changes and support adaptive control of therapeutic exposure. The integration of artificial intelligence, machine learning, advanced antenna systems, metamaterials, and computational electromagnetic modelling further enhances the potential for accurate localization, optimized energy distribution, and personalized treatment planning. This talk will explore the fundamental principles of microwave imaging and hyperthermia, their underlying electromagnetic relationship, current technological advancements, and the challenges associated with their integration. Particular emphasis will be placed on the emerging concept of image-guided microwave hyperthermia, where sensing, diagnosis, treatment, and monitoring become interconnected components of a unified system. This interdisciplinary approach could pave the way for smarter, safer, and more precise biomedical technologies, particularly in cancer management and next-generation non-invasive healthcare solutions.

ICEMSET-2026/FS/INV/517

Evaluating AI Hardware Restrictions in the Presence of Third-Country Cloud Providers

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Abstract

Artificial intelligence (AI) depends heavily on specialized inputs, making chip access a core issue for firms, supply chains, and public policy. Using game-theoretic modeling, we analyze how export restrictions on advanced AI chips impact an AI firm in a restricted destination that can access computing through two distinct channels. Under the direct route (Buy), the firm purchases and operates performance-restricted chips locally. Under the indirect route (Rent), a third-country cloud provider buys full-performance chips and sells computing power to the firm. Because the same supplier serves both channels, the rented option creates an alternative supply route that fundamentally reshapes the supplier's incentive to provide direct sales. This model reflects real-world dynamics where overseas cloud infrastructure provides access to advanced AI capabilities even when direct hardware exports are restricted.

ICEMSET-2026/FS/INV/518

Review of the Advances, Development, and Future Prospects of Polymers and Their Blends as Corrosion Inhibitors

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Abstract

Corrosion presents a critical industrial challenge, necessitating efficient, sustainable, and eco-friendly protection strategies. Synthetic polymers, natural biopolymers, and their synergistic blends have emerged as highly effective corrosion inhibitors for metals in aggressive acidic environments. This review systematically examines recent advancements in macromolecular corrosion mitigation, focusing on film-forming mechanism, adsorption isotherms, and quantum chemical electronic properties. Inherent heteroatoms, conjugated π-electron systems, and polar functional groups in polymeric architectures facilitate robust coordination with metallic surfaces, constructing protective physical barriers against corrosive species. Furthermore, polymer blending enhances inhibition efficiency, thermal stability, and solubility through intermolecular hydrogen bonding and synergistic film packing. Integrating inorganic nanocomposites with biopolymer matrices represents a paradigm shift toward next-generation anti-corrosive coatings. Key technical challenges, including elevated temperature degradation, solubility constraints, and long-term film durability, are critically evaluated. Finally, future research avenues focusing on smart, self-healing polymer matrix blends and sustainable green formulations are highlighted.

Keywords: Corrosion inhibitors, Synthetic polymers, Biopolymer blends, Adsorption mechanism, Nanocomposites, Synergistic inhibition.

ICEMSET-2026/FS/INV/519

Advanced Synthesis of Transition Metal Oxide Quantum Dots: A Novel Approach to Tailoring Their Physical Properties

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Abstract

The synthesis of Quantum Dots (QDs) is broadly classified into two approaches: top-down and bottom-up. A simple and rapid hybrid top-down method is proposed and demonstrated to synthesize MoO_3 transition metal oxide (TMO) QDs. One of the two top-down approaches used to synthesize QD is a combination of thermal evaporation and sonication-induced chemical etching process. In this work, highly stable and water-soluble MoO_3 QDs without any surfactants are successfully synthesized via this hybrid method. The growth mechanism of QDs in different crystalline phases as a function of acid concentration is exemplified in this work. The excitation-dependent Photoluminescence (PL) emission of MoO_3 QDs as a function of acid concentration is also investigated. The impact of sonication bath temperature on the morphological, microstructural, size, crystal-structural, and optical properties of MoO_3 QDs has been systematically investigated. The controlled sonication bath temperature during synthesis process results in the tunability of the QDs size. The mechanism behind the controlled size of the QDs is deeply rooted in the acoustic cavitation phenomenon. The sensing ability of these QDs is also investigated.

Keywords: TMO, QDs, Gas sensor.

ICEMSET-2026/FS/INV/520

Trustworthy Images, Trustworthy Science: AI-Assisted Forensics for Manipulated Micrographs and Spectra

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Abstract

Materials science rests on image evidence such as SEM/TEM micrographs, AFM maps, and diffraction and spectroscopy plots, yet duplicated, spliced and retouched figures remain a persistent integrity problem, and generative AI now makes convincing fabrication cheap. This talk presents an explainable, AI-assisted forensic pipeline for screening such figures. Complementary classical detectors, covering compression artefacts, noise inconsistencies and copy-move duplication, are fused through weighted ensemble scoring that localises suspicious regions and produces an auditable report rather than a black-box verdict. I discuss where classical methods remain robust, where deep-learning detectors add value, and why AI-generated micrographs call for provenance standards rather than detection alone. The talk closes with practical recommendations for authors, reviewers and journals: raw-data deposition, figure-level provenance, and human-in-the-loop screening in peer review.

Keywords: Image forensics; Research integrity; Explainable AI; Electron microscopy; Image provenance.

ICEMSET-2026/FS/INV/521

From Disease Surveillance to Smart Aquaculture: AI-Assisted Diagnostics, Functional Feed Innovations and Sustainable Fish Health Technologies

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Abstract

Aquaculture intensification has heightened challenges associated with infectious diseases, emerging pathogens, antimicrobial resistance and environmental stress, necessitating innovative approaches to aquatic animal health management. This presentation highlights research advances integrating disease surveillance, artificial intelligence (AI)-assisted diagnostics, functional feed technologies and eco-friendly disease management for sustainable aquaculture. Under the National Surveillance Programme for Aquatic Animal Diseases (NSPAAD), disease surveillance was conducted across aquaculture farms in all the districts of Tripura. Investigations involving pathogen isolation, phenotypic and molecular characterization, and antimicrobial susceptibility profiling documented diverse bacterial, fungal and parasitic pathogens, alongside the detection and molecular characterization, with sequence submission to GenBank. Investigations of biofloc-reared climbing perch (*Anabas testudineus*) also revealed emerging bacterial pathogens of reverse-zoonotic significance. Technological innovations include a prototype AI-based fish disease detection application and an AI-enabled Fish Health Diagnosing Device. Concurrent research on functional and therapeutic feeds encompasses fluconazole- and miconazole nitrate-based medicated formulations, nutraceutical interventions, bamboo leaf extract and detoxified rubber seed meal. Additionally, investigations on Mahua oil cake extract against *Argulus* infestation have contributed to the development of a plant-derived antiparasitic composition for which a patent application has been filed. Integrating digital disease surveillance, intelligent diagnostics, functional nutrition and phytogenic therapeutics offers a multidisciplinary framework for precision aquatic animal health management. These innovations have considerable potential to strengthen disease preparedness, promote responsible antimicrobial use, minimize environmental impacts and enhance sustainable aquatic food production.

Keywords: AI diagnostics; Disease surveillance; Functional feeds; Medicated feeds; Sustainable fish health.

ICEMSET-2026/FS/INV/522

Recycling and Performance Enhancement of Decommissioned Aircraft AA2014 Aluminium Alloy through Severe Plastic Deformation and Powder Metallurgy Routes

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Abstract

This study investigates recycling AA2014 aircraft wing scrap through equal channel angular rolling (ECAR) and powder metallurgy, integrating experimental characterization, statistical analysis and predictive modelling.

ECAR processing varied die angles, copper casing thicknesses and pass numbers, while powder metallurgy employed vacuum hot pressing and spark plasma sintering (SPS). Optimum ECAR processing at 90°, with 1 mm copper casing and three passes, achieved 215 HV hardness, 480 MPa ultimate tensile strength and 373 MPa yield strength. SPS delivered superior properties of 232 HV, 495 MPa and 390 MPa, respectively, with 95.68% relative density. SPS increased thermal conductivity to 135 $W \cdot m^{-1} \cdot K^{-1}$, improved wear resistance and decreased corrosion rate to 1.286 mpy. Statistical analysis identified ECAR passes as the dominant factor; regression models achieved R^2 values of 0.8110–0.8692. These findings demonstrate sustainable aerospace scrap recycling, with SPS providing the best overall performance.

Keywords: ECAR, SPS, powder metallurgy and performance.

ICEMSET-2026/FS/INV/523

Luminescence and Dielectric Studies of EuF_3: Gd @ Alanine Nanoparticles

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Abstract

EuF_3: Gd @ alanine was synthesized via aqueous solution route at room temperature. The XRD studies shows hexagonal phase of synthesized nanoparticles with lattice parameters a = b = 6.920 (A^0), c = 7.085 (A^0). The lattice parameter values are in good agreement with (JCPDS card no 32-0373). The particle size of nanoparticles was calculated using Debye-Scherer formula and it is found to be 43 nm. The variation in dielectric constant ε', dielectric loss ε'' and tangent loss (tan δ) with frequency (100 Hz – 5 MHz) was studied at room temperature. The dielectric constant and dielectric loss are found to decreases exponentially with frequency. The low value of dielectric loss at higher frequencies indicates its use in electronic industry. Under excitation EuF_3: Gd @ alanine nanoparticles shows emission at 654 (red) upon suitable excitation.

Keywords: Alanine; aqueous solution; dielectric constant; dielectric loss; tangent loss.

ICEMSET-2026/FS/INV/524

Cost-Effective Smart Microfluidic Device with Immobilized Silver Nanoparticles and Embedded UV-Light Sources for Synergistic Water Disinfection

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Abstract

This study presents a novel cost-effective microfluidic device for water disinfection that synergistically combines immobilized silver nanoparticles (AgNPs) with embedded germicidal UV-C light-emitting diodes (LEDs). The device was fabricated using an innovatively modified soft-lithography process with PDMS polymer, where multiple UV-C LEDs (30 mW each) were embedded as side-walls of a 300 µm wide, 500 µm high, and 10 cm long microchannel. AgNPs (20.83–42.10 nm) were synthesized via sodium borohydride reduction and immobilized on the microchannel surface through a silanization protocol using APTES. Experimental results demonstrated that the combined AgNPs and UV-LED treatment achieved ~99.4% disinfection efficiency against E. coli and B. subtilis at an optimal flow rate of 0.5 ml/min, significantly outperforming individual treatments (~94.8% for AgNPs alone; ~96.7% for UV alone). The device exhibited negligible silver leaching over 12 hours of continuous operation and remained effective for over 24 hours, disinfecting >1000 ml of contaminated water. At approximately 5 USD per unit, this compact, reusable device offers a 5–10 times cost-effective alternative to commercial UV-C water disinfection systems, making it a promising solution for point-of-use water treatment in resource-limited settings.

Keywords: Microfluidic device; Silver nanoparticles; UV-C LEDs; Water disinfection; Synergistic effect; Soft-lithography.

ICEMSET-2026/FS/INV/525

3D-Printed Impedance Micropump for Continuous Perfusion of Sample and Nutrient Medium Integrated with a Liver-on-Chip Prototype

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Abstract

This study presents a cost-effective, 3D-printed impedance micropump designed for continuous perfusion of samples and nutrient media in a liver-on-chip prototype. The micropump operates on the principle of impedance pumping, utilizing time-dependent periodic actuation of a flexible membrane to generate net fluid flow without the need for mechanical valves. The device was fabricated using fused deposition modeling (FDM) 3D printing, enabling rapid prototyping and low-cost production. Experimental characterization demonstrated stable flow rates suitable for maintaining cell culture viability and continuous nutrient supply. Integration with a liver-on-chip platform confirmed the micropump's capability to support long-term cell culture under dynamic flow conditions, mimicking the in vivo hepatic microenvironment. This 3D-printed impedance micropump offers a simple, disposable, and affordable solution for organ-on-chip applications, with potential for scaling to multi-organ systems.

Keywords: 3D printing; Impedance micropump; Liver-on-chip; Organ-on-chip; Continuous perfusion; Microfluidics.

ICEMSET-2026/FS/INV/526

Innovative Nanotechnology Solutions for Resource Recovery and Functional Materials for Energy and Environmental Applications

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Abstract

In recent years, agricultural biomass waste has emerged as a new and emergent source for extracting various platform chemicals and functions materials. With global estimates indicating the generation of over 5 billion tons of agro waste annually, sustained and green biomass source can be considered as an economically feasible and industrially viable source for extracting various useful products. Major contributors to this include crop residues such as rice husks, wheat straw, and corn stover, all of which possess substantial cellulose content. Utilizing this abundant waste not only alleviates environmental challenges related to disposal but also provides a renewable and sustainable feedstock for extracting various chemicals and functional materials. We at Sustainable Materials and Processes Lab develop various protocols, methods and approach that offers an eco-friendly alternative to generate new functional and platform chemicals following sustainable resource management practices while advancing the development of bio-based materials for a wide range of industrial applications, including water filtration, energy conversion, energy storage, packaging and so on. The versatility of extraction steps developed, particularly chemicals like cellulose from agri-biomass, allows for its effective integration into membrane technology, energy storage devices and protein packaging. Their inherent hydrophilicity, mechanical strength, and antifouling properties significantly improve membrane performance in various separation processes and as polymer matrix allows the easy modification of functionality that is suitable for energy conversion and storage applications. These attributes make agro-biomass a key resource for material extraction with environmentally friendly and sustainable systems, especially for water treatment, energy storage, protein packing and other critical applications. Consequently, the use of vast agro biowaste not only promotes sustainability but also contributes to advancements in eco-efficient technologies across multiple sectors.

Keywords: Agro-Waste, Bio-Based Membrane, Industrial Waste, Energy Storage, Energy Conversion, Water Treatment.

ICEMSET-2026/FS/INV/527

Regarding the Fermi-Dirac distribution function's adjustment in degenerate nano-semiconductors

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Abstract

Using a recently developed electron dispersion rule, an attempt is made to investigate the Fermi-Dirac distribution function in degenerate semiconductors that produce band tails (f_p). Using n-GaAs as an example, it seems that for larger values of N_i, f_p is more effective than f_0 and the influence of the carrier concentration (N_i) on f_p is more substantial than that of f_0. For a constant impurity screening potential, the relative change in the Fermi-Dirac function with respect to f_0 $((\Delta f / f_0), \Delta f = f_p - f_0)$ is initially zero and gradually declines as electron energy (E) increases. Following the minimum value, the $(\Delta f / f_0)$ rises at a comparatively modest pace as E grows, and f_p approaches to $f_0$with larger values of E. The current formulation gives us the means to examine the transport characteristics of degenerate semiconductors, which in turn rely on the Boltzmann transport equation's solution and should be more consistent with the experiments.

Keywords: Fermi-Dirac distribution function; degenerate semiconductors; band tails.

ICEMSET-2026/FS/INV/528

Nanoscience-Driven Thermal Interface Materials: Green Engineering Prospects of the CV22 Hybrid Metallic Architecture

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Abstract

Rapid miniaturization of electronic devices, escalating power densities, and the global demand for sustainable energy utilization have made thermal management a central challenge of modern engineering. Thermal Interface Materials (TIMs), which bridge microscopic gaps between heat-generating components and heat sinks, play a decisive role in ensuring efficient heat dissipation, reliability, and operational longevity. Conventional polymeric greases, pads, and fillers often suffer from limited thermal conductivity, aging, mechanical degradation, and environmental concerns. In this context, nanoscience offers transformative opportunities for the design of next-generation TIMs possessing superior heat transport characteristics with reduced ecological burden and sustainable carbon reduction counts. The present work introduces CV22 Hybrid Metallic Architecture, a novel nanoscience-driven paradigm in thermal interface materials based on engineered metallic nanostructures integrated within a hybrid matrix. The CV22 concept utilizes metallic nano-networks, micro-bridging pathways, and controlled interfacial architectures to create continuous thermal conduction channels while maintaining mechanical compliance and structural adaptability. By reducing phonon scattering and contact resistance at interfaces, the proposed architecture seeks to substantially enhance thermal conductivity compared with conventional TIM systems. A distinctive feature of the CV22 design lies in its green engineering orientation. The material philosophy emphasizes reduced dependence on hazardous additives, improved durability, recyclability of metallic constituents, and lower lifecycle energy losses through enhanced heat extraction efficiency. Better thermal regulation directly contributes to reduced energy consumption in electronic cooling systems, longer device lifespan, and minimization of e-waste generation. Such attributes align strongly with global sustainability goals and the transition toward environmentally responsible manufacturing practices. From an application perspective, the CV22 hybrid metallic TIM architecture holds promise for microelectronics, power electronics, electric vehicles, photovoltaic modules, LED systems, battery packs, aerospace electronics, and high-performance computing hardware. In these domains, efficient thermal pathways are indispensable for maintaining performance under increasing thermal loads. The adaptable hybrid framework further enables

customization according to operating temperature, pressure, and surface morphology requirements. This study discusses the scientific basis, conceptual framework, probable fabrication pathways, and anticipated thermo-mechanical advantages of the CV22 system. It also highlights the synergy between nanostructured metallic inclusions and hybrid host matrices in achieving multifunctionality—high thermal conductivity, low interfacial resistance, mechanical resilience, and environmental compatibility. In conclusion, the CV22 Hybrid Metallic Architecture represents an emerging direction wherein nanoscience converges with green engineering to redefine thermal interface materials for future technologies. By combining enhanced heat transfer performance with sustainability considerations, the proposed concept may serve as a strategic platform for next-generation thermal management solutions in an increasingly energy-conscious world.

Keywords: Green Nanotechnology, Thermal Interface Materials, Phase Change Materials, High Density Electronics, Chakravardhan22(CV 22).

ICEMSET-2026/FS/INV/529

Invariant Topological Modeling of Fingerprint Minutiae using Delaunay Triangulation for Biometric Verification

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Abstract

High-performance fingerprint recognition necessitates exceptional accuracy and resilience to acquisition artifacts, including rotational shifts, translational movements, and elastic deformation. The paper proposes a five-phase system for minutiae-centric verification leveraging Delaunay Triangula tion (DT) to generate a structurally invariant topological map. The methodology transforms discrete minutiae coordinates into a fixed, rigid network, substantially boosting local feature persistence and expediting the matching process. The system was validated against the FVC2002databases, yielding an Equal Error Rate (EER) of 1.01%. The method confirming the superior rotational and translational invariance provided by the topological matching approach.

Keywords: Fingerprint, DT, Minutiae, Matching, AFIS.

ICEMSET-2026/FS/INV/530

Semiconductor-Enabled AI and IoT for Smart Agriculture: Multimodal Intelligence for Climate-Resilient and Sustainable Farming

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Abstract

The convergence of semiconductor technologies, Artificial Intelligence (AI), Internet of Things (IoT), and advanced remote sensing is transforming traditional agriculture into intelligent, sustainable, and climate-resilient farming systems. This invited talk presents emerging innovations in smart agriculture, emphasizing the role of semiconductor-based sensors, low-power embedded devices, edge computing, and intelligent communication systems in enabling real-time agricultural monitoring and automation. A multimodal AI-IoT framework integrating soil and environmental sensor data, satellite imagery, and deep learning architectures, including Convolutional Neural Networks (CNNs), Long Short-Term Memory (LSTM) networks, and Transformers, is explored for crop stress detection, disease identification, yield forecasting, and precision irrigation. Furthermore, the talk examines intelligent decision-support systems for optimizing water and resource utilization under changing climatic conditions. Key challenges and future opportunities in energy-efficient sensing, data integration, explainable AI, and scalable deployment are discussed, highlighting the potential of emerging electronic technologies to strengthen agricultural productivity, food security, and sustainable farming.

Keywords: Smart Agriculture; Semiconductor Sensors; Artificial Intelligence; Internet of Things; Multimodal Deep Learning; Edge Computing; Precision Agriculture; Climate-Resilient Farming; Food Security.

ICEMSET-2026/FS/INV/531

Bridging Traditional Herbomineral Preparations with Modern Scientific Research

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Abstract

Kushta e Gaodanti is one of the Unani herbo-mineral formulations prepared by specialized process called calcination. This contains Gaodanti (gypsum) and Asganh (*Withania somnifera*), which have anti-inflammatory action and is used in arthritis. This study evaluated the anti-inflammatory and antioxidant properties of *Kushta e Gaodanti*, prepared using classical (KGC) and furnace (KGF) calcination methods, alongside a control sample lacking *W. somnifera* (KGW). Acute inflammation was induced in male Wistar rats via sub-plantar carrageenan injection. Paw diameter was measured over five hours using a plethysmometer, while blood serum was analyzed for malondialdehyde (MDA), catalase (CAT) activity, total antioxidant activity (AOA), and histopathology, using acetylsalicylic acid as a standard drug. All test samples reduced paw edema, decreased serum MDA, and elevated CAT activity and AOA compared to the carrageenan control. Low doses (70 mg) of KGC and KGF, as well as high doses (140 mg) of KGW, failed to suppress pro-inflammatory cytokines effectively. However, higher doses (140 mg) of KGC and KGF demonstrated efficacy comparable to acetylsalicylic acid, significantly reducing inflammation by suppressing the second phase of the inflammatory cascade and bolstering antioxidant activity.

Keywords: *Kushta e Gaodanti*, *Withania somnifera*, Anti-inflammatory, Antioxidant.

ICEMSET-2026/FS/INV/532

Design and Implementation of Indoor Visible Light Communication System

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Abstract

Visible Light Communication (VLC) is an emerging complementary wireless communication technology that integrates illumination and data transmission using existing lighting infrastructure. Standardized under IEEE 802.15.7, VLC offers a promising solution for short-range, high-speed wireless communication. This experimental study presents the design and implementation of a low-cost VLC system comprising ultra-bright 5 mm Light Emitting Diodes (LEDs) at the transmitter and a BPW34 silicon photodiode coupled with a TL081CP FET operational amplifier at the receiver. The system is experimentally evaluated over a transmission distance of 1 m, achieving a peak data rate of 1 Mbps using On-Off Keying Non-Return-to-Zero (OOK-NRZ) modulation. The experiments are conducted under realistic illumination conditions by considering five distinct transmitted optical power levels and different coverage scenarios. The primary objective is to investigate the influence of variations in transmitted optical power on the quality of the received signal and to develop corresponding models for the recursive channel representation. Furthermore, the study examines the effect of varying the feedback resistance and capacitance of the receiver's transimpedance amplifier (TIA) on received signal quality at different transmitted optical power levels. The experimental findings provide insights into the interplay between transmitted optical power, receiver circuit parameters, and signal quality, thereby contributing to the optimization of low-cost VLC system design for reliable short-range wireless communication.

Keywords: Light emitting diodes; Photodiodes; Quality factor; Visible light communication.

ICEMSET-2026/FS/INV/533

Synthesis and characterization of rGO/NiO nanocomposites

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Abstract

In this study rGO/NiO nanocomposites were synthesized and characterized by different techiques. The XRD pattern shows the formation of rGO/NiO nanocomposites. Raman spectroscopy shows the effect of increasing rGO content on the I_D/I_G ratios and to study the additional structural defects. UV–Vis show a slight narrowing of the band gap of the composites due to π–d orbital coupling at the rGO-NiO interface. FESEM images show well-dispersed NiO nanoparticles, EDX and elemental mapping confirmed the uniform spatial distribution of Ni, O and C elements. FTIR spectra exhibited characteristic Ni─O vibrational modes accompanied by a decrease in oxygenated carbon functionalities.

Keywords: NiO nanoparticles, rGO/NiO nanocomposites, band gap, Nanocomposites.

ICEMSET-2026/FS/INV/534

Layered Double Hydroxides Meet Low-Dimensional Sulfides: A Charge Separation Strategy for Solar CO_2 Recycling

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Abstract

Photocatalytic carbon dioxide reduction (PCRR) remains hampered by limited light absorption and rapid electron-hole recombination in single-component systems1. To address these challenges, we engineered two distinct heterojunctions by integrating two-dimensional nickel–iron layered double hydroxides (2D-NiFe-LDH) with either zero-dimensional silver(I) sulfide (Ag_2S) or two-dimensional tin(II) sulfide (SnS) at varied concentrations. Both architectures exhibited synergistic interactions with the LDH matrix, manifesting in sharper optical absorption edges and significantly enhanced surface area and porosity. Scanning tunneling microscopy revealed Ag and S ion migration onto the LDH lattice in Ag_2S composites, whereas SnS sheets intercalated deeply into the LDH structure. X-ray photoelectron spectroscopy (XPS) and electron paramagnetic resonance confirmed increased delocalization of hydroxyl radicals upon heterojunction formation. Nitrogen adsorption–desorption isotherms (BET) further validated the surface area and porosity enhancement, with the SnS-modified LDH outperforming its Ag_2S counterpart due to the planar nature and interlayer penetration of SnS. Electronic structure analyses, including valence band spectra, Mott–Schottky plots, and interfacial band alignment, unveiled distinct charge separation mechanisms: Ag_2S/NiFe-LDH formed an S-scheme heterojunction2, while SnS/NiFe-LDH adopted a p–n type configuration. Both systems exhibited superior PCRR activity compared to pristine LDH. Under visible light irradiation, the optimized NFAS15 (15 wt% Ag_2S) heterojunction achieved CO and CH_3OH
yields of 20.7 μmol g^{-1} h^{-1} and 2.9 μmol g^{-1} h^{-1}, respectively. In comparison, the SnS-modified LDH with 20 wt% loading exhibited significantly enhanced photocatalytic performance, producing CO and CH_3OH at 60.76 μmol g^{-1} h^{-1} and 5.4 μmol g^{-1} h^{-1}, respectively. Although the Ag_2S/NiFe-LDH system benefits from an efficient Sscheme charge separation, the superior intercalation and lattice integration of 2D SnS sheets into the LDH framework offer a more effective route for enhancing PCRR activity.

Keywords: CO_2 photoreduction; LDH-sulfide interface; S-scheme and Type II heterojunction; Photocarrier lifetime; In-situ EPR.

ICEMSET-2026/FS/INV/535

Smart Agriculture technologies using IoT to boost productivity in Horticulture crops

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Abstract

The world population will increase roughly by 25% by the end of 2050, requiring food production to double and also it should meet shifting dietary preferences. The Internet of Things (IoT) enables the production of agricultural process-supporting systems. IoT will smooth the progress of remote monitoring systems, decision support tools, automated irrigation systems, pest and disease forecasting heavy rainfall prediction systems and fertilization systems. Farmers and researchers must be provided with a detailed understanding of IoT applications in agriculture as a result of the knowledge described above integrating wireless sensor networks (WSN) to track temperature and Crop Water Stress Index (CWSI) values will help in automated and targeted water delivery. Sensor-based computer applications will facilitate regulating the environmental parameters via manual or proportional control mechanisms to optimize yields and eliminate risks associated with human error. Transitioning from traditional database limits to cloud storage will help to handle massive sets of "big data" streaming continuously from field sensors. Utilizing predictive algorithms helps to monitor real-time crop reputation and precisely forecast optimal harvesting windows. Emphasizing that raw data is useless without robust analytics tools and algorithms to derive actual operational insights. However, the vulnerability of physical sensors to outdoor damage is a critical challenge which has to be addressed carefully. Because sensors act as the "eyes and ears" of an IoT system, any hardware failure can corrupt data streams, leading to incorrect automated decisions, such as over watering a crop or missing early signs of forecasting of pest and disease attack. Hence care should be taken while using Internet of Things (IoT) technologies and techniques to enhance agriculture.

Keywords: Internet of Things (IoT), Crop Water Stress Index, wireless sensor networks.

ICEMSET-2026/FS/INV/536

Glowing Green Bricks: Bio-Integrating Bacterial Pyoverdine with Circular Polymers for Toxic-Free Luminescence

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Abstract

The circular materials innovation focuses on the valorisation of plastic waste and construction materials. This study demonstrates the fabrication of recycled-plastic bricks functionalised with bacterial pyoverdine, a naturally fluorescent siderophore. Institutional plastic waste was collected, cleaned, size-reduced, thermally processed and moulded into bricks, with approximately 1 kg used per brick. Pyoverdine was produced using *Pseudomonas aeruginosa*, recovered from culture supernatant and deposited onto brick surfaces by spray coating. The fabricated bricks exhibited reported compressive-strength readings of 10.8 and 9.6 kN/min and water absorption values of 0.21% and 0.13%, respectively. Pyoverdine-functionalised surfaces displayed fluorescence under ultraviolet illumination, establishing the feasibility of imparting a bio-derived fluorescent response to recycled polymer-based construction units. Although fluorescence under ordinary street lighting remained limited, these findings provide a proof of concept for valorising plastic waste and incorporating biological fluorophores into functional building materials for sustainable infrastructure. Further optimisation should address fluorescence intensity, photostability, coating durability, pigment leaching and biosafety.

Keywords: Sustainable plastic bricks, Recycled plastic bricks, Plastic waste valorisation, Pyoverdine.

ICEMSET-2026/FS/INV/537

Cost effective design of RC building frame employing unified particle swarm optimization

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Abstract

Present work deals with the cost-effective design of reinforced concrete building frame employing unified particle swarm optimization (UPSO). Two building frames with G+8 stories and G+10 stories have been adopted to demonstrate the effectiveness of the present algorithm. Effect of seismic loads and wind load have been considered as per Indian Standard (IS) 1893 (Part-I) and IS 875 (Part-III) respectively. Analysis of the frames has been carried out in STAAD Pro software. The design loads for all the beams and columns obtained from STAAD Pro have been given as input of the optimization algorithm. Next, cost optimization of all beams and columns have been carried out in MATLAB environment using UPSO, considering the safety and serviceability criteria mentioned in IS 456. Cost of formwork, concrete and reinforcement have been considered to calculate the total cost. Reinforcement of beams and columns has been calculated with consideration for curtailment and feasibility of laying the reinforcement bars during actual construction. The numerical analysis ensures the accuracy of the developed algorithm in providing the cost optimized design of RC building frames considering safety, serviceability and constructional feasibilities. Further, Monte Carlo simulations performed on the numerical results, proved the consistency and robustness of the developed algorithm. Thus, the present algorithm is capable of giving a cost-effective design of RC building frame, which can be adopted directly in construction site without making any changes. The probability of total cost falling within each interval was estimated considering 5000 forecasted outcomes. These probability values obtained for 20 intervals for L-shaped frames respectively. Both the plots clearly depict the nature of a normal distribution curve. The most likely outcome is at the middle of the curves, meaning there is an equal chance that the actual outcome will be higher or lower than that value. The key percentile shows the likely values of the total cost of frames. For example, the key percentile value against the 25% shows that there is 25% chance that the developed algorithm will provide this total cost. Similarly, key percentiles for 50% and 75% chance have also been evaluated. Also, the total cost corresponding to 99% for both the frames also proves that there is negligible scope for design failure by the developed algorithm. Loss percentile is calculated keeping the maximum total cost to be Rs. 39, 00,000 for L-shaped. The loss percentile shows that there is only 2% chance of the total cost to exceed Rs. 39, 00,000 for L-shaped frame which are very close to first simulation values. The loss percentages are found to be very negligible. Therefore, the optimum design of the frames using the developed algorithm is not only found safe in every experiment but it also provide an optimum overall cost almost every time. The positive findings of the research will encourage the future researchers to improve the present algorithm to incorporate more minute reinforcement details such as development length, ductile detailing etc.

ICEMSET-2026/FS/INV/540

Quantum Computing in Space

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Abstract

The convergence of Quantum Computing and Space Technology is opening new frontiers in space exploration, mission intelligence, and scientific discovery. By harnessing quantum principles such as superposition and entanglement, quantum computing offers promising approaches to computationally intensive challenges that extend beyond the capabilities of conventional methods. This talk explores emerging applications of quantum algorithms in spacecraft trajectory optimization, Space Situational Awareness, satellite image processing, quantum-assisted navigation and secure space communications. Particular emphasis will be placed on hybrid quantum-classical computing approaches, including quantum optimization and machine learning, for addressing complex space engineering and mission-planning problems. The discussion will also examine the technological challenges of quantum computing in space, including decoherence, radiation effects, scalability, and fault tolerance. Ultimately, the talk envisions a quantum-enabled space ecosystem that can accelerate autonomous missions, enhance space security, and expand humanity's capabilities in space exploration.

Keywords: Quantum Computing; Space Technology; Quantum Optimization; Space Situational Awareness; Hybrid Quantum-Classical Computing.

ICEMSET-2026/FS/INV/541

Torsional Wave Propagation in Initially Stressed Transversely Isotropic Composite Poroelastic Cylinders

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Abstract

This talk consists of study of characteristics of torsional waves in initially stressed, transversely isotropic composite poroelastic cylinders within the framework of Biot's poroelastic theory. The study considers a two-layer cylindrical structure consisting of an inner solid core and an outer hollow substrate, with different material properties. The governing equations of motion and the corresponding frequency equation are derived using appropriate boundary and interface conditions. For numerical results, composite materials namely Berea sandstone and shale rock in different arrangements, and cylindrical bone implanted with titanium are employed. Numerical analysis is carried out to examine the influence of wavenumber, material anisotropy, thickness ratio and initial stress on phase velocity. The results reveal that initial stress significantly affects the phase velocity. The material arrangement and geometrical parameters also influence the torsional wave propagation characteristics. The study concludes that initial stress plays an important role in the dynamic behaviour of composite poroelastic cylinders and provides a theoretical basis for understanding wave propagation in layered porous materials, with potential applications in geophysical and biomechanical engineering.

ICEMSET-2026/FS/INV/542

Emerging fungal and viral diseases of cultivated mushrooms: challenges in diagnosis and strategies for effective management

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Abstract

Mushroom cultivation is affected by several fungal and viral diseases that adversely affect crop health, productivity and yield. Wet bubble disease (*Mycogone perniciosa*), cobweb disease (*Cladobotryum dendroides*) and green mould caused (*Trichoderma* sp.) were identified as major diseases affecting cultivated mushrooms. Wet bubble disease of button mushroom recorded as major disease with 27.21% overall incidence and 22.07% crop loss. Molecular detection through quantitative real-time PCR (qPCR) revealed the presence of four mycoviruses, namely Oyster mushroom spherical virus (OMSV), *Pleurotus ostreatus* virus 1 (PoV1), Mushroom bacilliform virus (MBV) and La France isometric virus (LIV), in *P. ostreatus* and *P. ostreatus* var. *florida*. Among these, OMSV exhibited the highest expression relative to the healthy control. Furthermore, biological management using a bacterial consortium comprising *Pseudomonas fluorescens*, *Bacillus proteolyticus* and *P. putida* significantly reduced wet bubble disease intensity to 4.45%, achieving 75.89% disease control compared with 18.46% disease intensity in the inoculated untreated control.

Keywords: Mushrooms, Fungal pathogens, Mycoviruses, qPCR detection, Biological control.

ICEMSET-2026/FS/INV/544

NeuroSonic: An Innovative Neuroacoustic Therapy to Enhancing Mental Wellness with EEG Brain Signal

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Abstract

The research work describes an in-depth analysis of the neurological response of different brain lobes in resting and motor task situations. Leveraging electroencephalography (EEG) data obtained from participants engaged in rest intervals and motor tasks, the research aims to elucidate the distinct patterns of neural activation across different brain lobes. Through meticulous statistical analysis of EEG signals, the underlying mechanisms

governing brain activity during these conditions are explored using EMOTIVE. The study employs advanced signal processing techniques and statistical analysis to discern temporal and spatial dynamics in neural responses. In this research work, EEG data has been collected from 60 no. of subjects both male and female. ANOVA analysis is used for statistical representation. Results extend the understanding of brain function in resting and task-oriented states by analyzing the distinct features of neural activity in various brain lobes. The challenging job is the mapping EEG data and integrating it into the proposed device. It optimizes therapeutic auditory experiences to each person's unique brainwave patterns using EEG data and accurate frequency analysis, encouraging mental endurance and emotional well-being. By creating customized sonic settings that adhere to accepted theories of sonic and neuroacoustic treatments, this method maximizes the therapeutic potential of sound and improves mental health results.

Keywords: Brain activity, brain lobes, ANOVA, linear best-fit curves, neural response.

ICEMSET-2026/FS/INV/545

Computational Design of Oligoacenes and their cation-π complexes and their electronic properties

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Abstract

Computational techniques to design molecules of novel and desired properties have attracted a lot of interest in the past few years involving intermolecular interactions in cation- systems because of their utility in molecular recognition, creation of molecular materials with desirable physical properties. The focus of this theoretical computational investigation is to tune oligo-acenes as a high mobility semiconductor in the field of optoelectronic devices. It has also been realized and discussed that the relevance of this designing stems from a delicate balance of competing and cooperative phenomenon like carrier mobility, charge transport, reorganization energies, singlet-triplet gap, binding energy, barrier height calculated using DFT based methods and the influence of counterions to the cation- surface. The study of counterions in cation- systems yields valuable information in understanding crystal packing and also in the transport of ions.

Keywords: Reorganization energy; carrier mobility; binding energy; barrier height; singlet-triplet gap.

ICEMSET-2026/FS/INV/546

Tailoring Non-Thermal Microwave Plasma via Dielectric Topologies and Metallic Sleeve for Agriculture

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Abstract

Growing consumer demand for healthier food products has increased the need for sustainable, cost-effective technologies, such as plasma-activated water (PAW), which has promising applications in agriculture and medicine. PAW is produced by weakly ionized gases that generate energetic species, reactive oxygen and nitrogen species (ROS and RNS), UV radiation, and electric fields, thereby modifying water chemistry. However, precise control over plasma volume, reactive species generation, and particle delivery remains challenging. This study numerically investigates the non-thermal behavior and spatial tailoring of a microwave argon plasma column using an integrated dielectric ring and metallic sleeve. The dielectric ring enhances the local electric field by approximately 30%, while the metallic sleeve guides wave propagation and extends plasma length. Sleeve positioning, length, and gap significantly influence plasma distribution. The proposed hybrid source enables flexible control of plasma profile and particle flux while maintaining non-thermal conditions, with bulk plasma temperatures below 2 eV.

Keywords: Plasma-activated water, Microwave plasma, Non-thermal plasma.

ICEMSET-2026/FS/INV/547

Antimicrobial activity evaluation of Ethanolic Garlic Extract and Garlic-Loaded Chitosan Nanoparticles (GCNPs) against *Aeromonas hydrophila*- An In vitro Comparison Study

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Abstract

The present study aimed to develop and characterize garlic-loaded chitosan nanoparticles (GCNPs) as a natural antimicrobial formulation against *Aeromonas hydrophila*. Ethanolic garlic extracts were prepared. Chitosan nanoparticles (CNPs) and GCNPs were synthesized via ionic gelation using sodium tripolyphosphate and characterized by DLS, zeta potential, FTIR, TEM, SEM, and UV–Visible spectroscopy. In vitro release kinetics demonstrated a controlled and sustained release profile of garlic bioactive compounds from the chitosan matrix, indicating effective protection and prolonged availability of the antimicrobial agents. Antibacterial assays revealed that ethanolic garlic extract exhibited stronger activity with inhibition zones of 17.33±0.5–23.33±0.5 mm, an MIC of 15.625 mg/mL compare to GCNPs produced an inhibition zone of 18±0.5 mm and an MIC of 15 mg/mL, though the MBC was higher (60 mg/mL), suggesting controlled release kinetics. These findings indicate that GCNPs possess high encapsulation efficiency, favorable nanoscale properties, sustained release behavior, and retained antibacterial efficacy. The present study supports ethanolic garlic extract and garlic-loaded chitosan nanoparticles to serve as promising alternative or complementary natural antimicrobial formulations against *A. hydrophila* infection in aquaculture. However, as nanoencapsulation improve statbility of bioactive compounds responsible for the antibacterial activity of garlic extract, GCNPs can be a better alternative approach for bacterial disease management in aquaculture. Future in vivo studies, together with field validation, are warranted to confirm and extend the applicability of these findings under practical conditions.

Keywords: Nanoencapsulation, GCNPs, FTIR, TEM, SEM, Antibacterial assays.

ICEMSET-2026/FS/INV/548

Zinc Oxide Nanocomposites with Metal/Carbon Based Materials for Photocatalytic, Antibacterial and Sensing Applications

Anupama Chanda, Vaishali Amrute

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Abstract

Metal oxide semiconductors have gained tremendous interest in environmental remediation. Among them, ZnO owing to its unique physical and chemical properties exhibits versatility as an efficient photocatalyst, antibacterial agent and sensor. In some cases, ZnO serves as the main component while in others it plays a supporting role to enhance key properties. ZnO doped with a novel element silver (Ag) showed excellent photocatalytic activity against methylene blue dye which was achieved in the shortest period ever reported when irradiated under the solar light. ZnO coupled with 2 dimensional (2-D) carbon-based materials such as graphene oxide (GO) and reduced graphene oxide (rGO) demonstrate superior performance of rGO/ZnO nanocomposites in terms of photocatalytic activity and antibacterial activity. The cooperative effect of Ag and GO on ZnO exhibited enhanced photocatalytic and humidity sensing performance demonstrating the utility of Ag-ZnO/GO nanocomposite for both water and air quality monitoring.

Keywords: ZnO, Nanocomposite; Photocatalytic activity; Antibacterial activity; Humidity sensing.

ICEMSET-2026/FS/INV/549

Numerical Investigation of Energy Spectrum Modulation and Control in an Isolated GaAs/AlGaAs Quantum Well under an In-Plane Magnetic Field

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Abstract

The energy spectrum of electrons in an isolated GaAs/AlGaAs quantum well under a uniform static magnetic field applied parallel to the heterointerfaces is investigated using a numerical approach. The eigenvalue equation governing the electron energy states is solved numerically by formulating the problem as a two-point boundary value problem. Unlike conventional approaches that rely on analytical expressions for the eigenfunctions, the proposed method directly determines the energy eigenvalues without requiring any predefined analytical form of the wavefunctions. To the best of our knowledge, this is the first application of this numerical method to this classical problem in nanostructure physics. The reliability and accuracy of the approach are examined through two distinct cases, for which the calculated results show excellent agreement with established standard results wherever available. This agreement confirms the effectiveness of the proposed numerical procedure. The method provides a straightforward and flexible alternative for investigating the energy spectrum of semiconductor quantum well structures in the presence of an in-plane magnetic field. Overall, this work introduces a novel numerical framework for the computational study of electronic states in low-dimensional semiconductor nanostructures.

Keywords: Electron Confinement; Quantum Mechanical Eigenvalue Problem; Magneto-Electronic Properties; Low-Dimensional Systems, GaAs-AlGaAs.

ICEMSET-2026/FS/INV/552

Multi-objective optimization framework for hydrogen production with low carbon emission: Computational design of advanced reactor systems

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Abstract

Hydrogen production involves trade offs among conversion, selectivity, energy efficiency and greenhouse gas emissions. This work presents a computational framework based on single and multi objective optimization for the design and operation of advanced reactor systems for hydrogen production. Using tri reforming process as a case study, we compare cylindrical, spherical, and membrane reactor configurations. Solutions of multi-objective problems reveal that the trade-off exists between maximization of H_2 yield and energy efficiency while minimizing carbon emissions and hydraulic power consumption. The results also showcase the optimal operating windows and help selecting a reactor type and process conditions. The methodology is broadly applicable to energy material systems relevant to emerging technologies and illustrates the role of computational tools in sustainable process design in a sustainable manner.

Keywords: Hydrogen production; Low-carbon emission; Multi-objective optimization; Computational design.

ICEMSET-2026/FS/INV/553

Low-Cost Carbon Dots from Galgal Juice for Ultraviolet Monitoring Applications

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Abstract

The synthesis of carbon dots (CDs) via a green route using natural precursor exhibits unique properties, making them a promising candidate for various applications. In this work, we utilized hill galgal juice for synthesizing

CDs using a cost-effective one-step hydrothermal-assisted green method. In this work, we investigated the crystal phase and optical properties of the synthesized sample using various techniques, including X-ray diffraction (XRD), field-emission scanning electron microscopy (FE-SEM), Raman spectroscopy, UV–Vis spectroscopy, and photo luminescence spectroscopy. The resulting CDs exhibited an increased interlayer spacing of about 4.02 Å and a wide optical bandgap of ~3.2 eV, which can be attributed to the oxygen-containing groups bonded to their surfaces. Under ultraviolet irradiation, the synthesized CDs showed intense bluish-green fluorescence with strong photoluminescence behavior. Furthermore, a room-temperature ultraviolet sensor was successfully fabricated using the prepared sample, which demonstrated a sensing response of 9% without requiring any complicated fabrication procedure. The synthesized carbon dots also exhibited a quantum yield of 22 %.

ICEMSET-2026/FS/INV/554

Introduction of Fluid Dynamics with Gyrotactic Organism

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Abstract

The flight of birds, an airplane in the air and the motion of fish in water are governed by principles of fluid mechanics. It is a subject of prime importance in engineering, astrophysics, geophysics, meteorology, space technology, and medicine. Biomedical process also finds this type of applications. Biofluids often exhibit non-Newtonian characteristics due to the inclusion of living cells or microorganisms that alter the fluid's viscosity, density, and flow properties. Lab-based experiments will be conducted using biofluids containing *gyrotactic microorganisms* that exhibit directional swimming due to environmental gradients, such as *Chlamydomonas or E. coli*. The study of biofluid dynamics, specifically the behaviour of *gyrotactic fluids*, has gained increasing attention in recent years due to its relevance to various natural systems and technological applications. Prior research has shown that gyrotactic microorganisms influence viscosity, density, and flow-induced transport in biofluids. Existing work focuses on basic gyrotactic motion, bioconvection patterns, and their role in natural systems. However, very limited research addresses gyrotactic fluid behaviour over stretching surfaces with MHD, chemical reaction, and non-Newtonian rheology included simultaneously. We anticipate that the results of research will provide new insights into how microorganisms influence macroscopic fluid flows with effect of MHD and other parameters.

Keywords: Chemical reaction, Gyrotactic microorganisms, MHD, non-Newtonian fluid, Stretching surface.

ICEMSET-2026/FS/INV/555

Ligand-Engineered Eu(III) Metal–Organic Frameworks on Functionalized g-C_3N_4: From Multi-Mode Optical and Electrical Sensing of VOC to a Low-Cost Optoelectronic Device

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Abstract

Rapid on-site detection of trace pollutants requires sensing materials whose optical and electrical responses can be read by simple electronics. We present a family of Eu(III) metal–organic frameworks (MOFs) in which benzoic acid-functionalized g-C_3N_4 acts as a structure-directing, light-harvesting ligand. Combining this ligand with MoS_2 and terephthalic acid gave a framework with both metal- and ligand-centred emission, enabling ratiometric fluorescence detection of the carcinogenic solvent 1,4-dioxane which is a volatile organic compound (VOC). The sensor responded within 5 s, reached a detection limit of 0.026 ppm, far below the 10 ppm regulatory level, and distinguished dioxane from 16 other solvents. Density functional theory links this selectivity to photoinduced electron transfer between aligned host and analyte energy levels. The same material

shows a pink-to-blue colour change under UV light and altered current–voltage behaviour in dioxane vapour. We also report progress towards a portable Arduino-based UV-LED/photodiode prototype and the illumination optimisation it requires.

Keywords: Lanthanide metal–organic framework; Functionalized g-C_3N_4; Ratiometric fluorescence sensing; VOC; Low-cost optoelectronic sensor.

ICEMSET-2026/FS/INV/556

Exploitation of a Triphenylamine-Based Star-burst Compound for Multifunctional Applications: Anticorrosion, Antidiabetic, Antioxidant, and Computational Insights

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Abstract

In the present investigation, the synthesized triphenyl-based star-burst compound of pentyl-substituted naphthalene (P1NTT) compound was utilized as an inhibitor of corrosion for Fe (110) surface in 1 M HCl activation under static conditions. According to electrochemical impedance spectroscopy (EIS) studies, at a concentration of 0.400 g/L of P1NTT, the charge transfer resistance increased from 11.12 to 55.33 Ωcm2 . Additionally, quantum chemical calculations using density functional theory (DFT) demonstrated the inhibitor's reactivity and adsorption characteristics, which were confirmed by Fukui functions, Fractional Free Volume (FFV), and Monte Carlo (MC) simulations. Further, antidiabetic and antioxidant tests were conducted in vitro to assess the pharmacological efficacy of P1NTT compound. The EC50 values for α-amylase and α-glucosidase inhibition which were used to measure the antidiabetic action were 55.68 µg/mL ± 0.28 and 53.89 ± 0.43 µg/mL, respectively. The ligand (P1NTT) and α- amylase (1B2Y)/ α-glucosidase (3WY1) protein interaction was examined through the molecular docking studies. In the H2 O2 assay, the antioxidant activity of P1NTT peaked at an enzyme inhibition percentage of 86.21%. The findings of this investigation show that P1NTT has encouraging anticorrosion, antidiabetic, and antioxidant qualities, opening the door for its use in chemical and healthcare industries.

Keywords: Antidiabetic | corrosion inhibitor | fractional free volume | molecular docking | star-burst compound.

ICEMSET-2026/FS/INV/557

Eclosion Behavior and fitness studies in *D. melanogaster* in dark condition

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Abstract

Evolutionary adaptation refers to inherited features that enhance survival or reproduction of an organism. The circadian rhythm has genetic basis, hence it must be involved in the evolutionary adaptation of an organism. It is an attempt to understand the adaptive significance of *D. melanogaster* maintained in DD condition in terms of Darwinian fitness. Aim of the study is that, in the absence of light an organism loose or gains its fitness, to address this issue *D. melanogaster* flies were kept continuously in DD for 30 generation. Every fifteen generation the flies were analyzed for their ability to lay eggs (fecundity), viability and eclosion rhythm. About 36%, 28% and 34% of eggs were recorded in control, 15th and 30th generation respectively. There is a slight decrease in fifteenth generation; again the fecundity values are almost equal to the control in 30th generation. Viability among different generation showed significant difference. Eclosion rhythm showed phase shift in the

emergence peak both in 15th and 30th generation when compared to control. Probably the generations are not enough to disturb the endogenous clock or photoperiod have little effect on the fitness of an individual.

Keywords: *D. melanogaster*, circadian rhythm, fecundity, viability, eclosion.

ICEMSET-2026/FS/INV/558

Sustainable Polymers: The roles of Bio-polymers

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Abstract

Polymers are one of the most useful materials in the modern world. Polymers are generally bio-degradable and non-biodegradable. A degradable polymer in which the degradation results from the action of naturally occurring microorganism from environment. The polymers are known to have good insulating properties and used to coat metal wires to prevent electric shocks. Conducting polymers are organic polymers or bi-polymers that conduct electricity as metallic conductors or semiconductors. Conducting polymers are conjugated pi-system polymers such as polyacetylene. Transfer of electrons in the polymer chain proceeded by doping of halogen. The halogen molecule attracts an electron from the polyacetylene chain and positively charge polyacetylene molecule forms known as Polaron. The conductivity depends on density of charge carriers and their mobility also. The conductivity of polymers decreases with falling temperature in contrast to the conductivities of the metals. Electromagnetic shielding for computers, Lasers used in the flat television, anti-static substances for photographic are the recent developing applications of the conducting polymers. So, both the biodegradable and the conducting polymers are good for the green environment.

Keywords: Biodegradable, Conducting polymers, Polyacetylene, Polaron, Green environment.

ICEMSET-2026/FS/INV/559

Signal Integrity Issues in Carbon Nanotube Based High-Speed On-Chip Interconnect Technologies

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Abstract

As semiconductor technology advances towards nanoscale dimensions, ensuring signal integrity in high-speed on-chip interconnects has become a critical challenge due to crosstalk noise, propagation delay, and electromagnetic coupling. This invited talk presents a comprehensive performance analysis of mutually coupled multi-walled carbon nanotube (MWCNT) interconnects and their comparison with conventional copper (Cu) interconnects at the 22nm technology node. A wavelet-based Multiresolution Time-Domain (MRTD) numerical approach is employed to investigate functional and dynamic crosstalk characteristics, including victim-line propagation delay and peak noise voltage under different switching conditions and load capacitances. The proposed model is evaluated against conventional Finite-Difference Time-Domain (FDTD) techniques and validated using HSPICE simulations. The comparative results demonstrate that MWCNT interconnects offer substantial reductions in crosstalk-induced delay and noise voltage compared with copper. These findings highlight the potential of MWCNT technology for reliable, high-speed, and energy-efficient VLSI interconnect design in future nanoscale integrated circuits.

Keywords: Crosstalk; On-chip Interconnects; Signal Integrity; Multiwalled carbon nanotubes; Copper.

ICEMSET-2026/FS/INV/560

Comparative Growth and Physiological Parameters of Tomatoes under pilot scale Hydroponics and Soil Cultivation set-up inside a Polyhouse

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Abstract

Polyhouse cultivation is steadily becoming popular in India these days. The advantages of protected cultivation inside polyhouse are numerous. Another technology, hydroponics, is also slowly getting interest of growers these days. There are many benefits of hydroponics over soil cultivation thus it can sustainably support high yield of tomato to achieve UN SDGs. To evaluate the basis of higher yield under HC, we conducted a comparative study of various growth parameters in hydroponics and soil grown of San Marzano 3 heirloom variety of tomato inside polyhouse. Plant height, leaf area, chlorophyll contents were higher in HC when compared to SC. In contrast leaf number was reduced in HC. Moreover, the flowering initiation time and the number of flowers were also reduced in HC system. Antioxidant system showed lesser induction under hydroponics system as compared to soil grown tomatoes. The photosynthetic machinery was also working better in hydroponics conditions. As compared to soil cultivated plants, the nitrate content was higher in hydroponically grown plants but still much lower than the permissible limits. These results indicate that under optimal nutrient supply and well-maintained conditions (hydroponics) plants show better vegetative growth.

ICEMSET-2026/FS/INV/561

AgriGenius: A Multi-Agent Framework for Crop Care from Seed to Sale

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Abstract

Farmers rely on disconnected sources for crop selection, financing, crop protection, yield estimation and market access, leading to delayed decisions, higher costs and lower profits. This paper proposes AgriGenius, a multi-agent AI framework providing end-to-end support from seed to sale. A central orchestrator agent coordinates specialized agents for crop recommendation based on soil, weather and water availability; loan and insurance guidance; continuous crop health monitoring from planting to harvest; yield prediction; and market intelligence identifying the best time and place to sell. Together, they analyze data from diverse sources to deliver personalized, real-time recommendations at every stage. The system is being piloted with approximately 20 farmers in Warangal District, Telangana, using region-specific agricultural and market data, on an architecture designed to scale to other districts and states. By unifying these services in a single platform, AgriGenius aims to improve decision-making, productivity and farm income while promoting sustainable agriculture.

ICEMSET-2026/FS/INV/562

Ion-Beam-Induced Nanopatterning of Surfaces: Opportunities for Tribological Applications

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Abstract

Surface nanopatterning offers an effective approach to tailoring the functional properties of materials by controlling their surface morphology at the nanoscale. Ion-beam irradiation, particularly focused ion beam (FIB) techniques, provides versatile opportunities for fabricating well-defined nanostructures with controlled dimensions and surface topographies. This talk will highlight recent developments in ion-beam-induced nanopatterning, focusing on the morphological evolution of silicon surfaces and their nanoscale interfacial properties. The role of surface morphology in governing adhesion and contact interactions, investigated using atomic force microscopy (AFM)-based techniques, will be discussed. Particular emphasis will be given on the

potential of engineered surface nanostructures for controlling friction, adhesion and wear. The discussion will highlight the opportunities offered by ion-beam-based surface engineering for developing advanced functional surfaces with tailored tribological properties.

Keywords: Ion Beam, Nanopatterning, Atomic Force Microscopy, Tribology, Adhesion and friciton.

ICEMSET-2026/FS/INV/563

Agentic AI and Edge Intelligence for Semiconductor-Enabled Smart Sensing: A Case Study in Precision Agriculture

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Abstract

The integration of Artificial Intelligence (AI), Internet of Things (IoT), and edge computing is transforming semiconductor-enabled smart sensing systems. This talk presents a research-oriented case study on AI and IoT-based intelligent sensing for precision agriculture, focusing on the integration of sensor networks, remote sensing, machine learning, and edge intelligence for data-driven agricultural decision-making. The proposed framework explores how semiconductor-enabled sensing devices and embedded computing platforms can facilitate real-time environmental monitoring, sensor data analytics, crop condition assessment, and intelligent decision support. Particular emphasis is placed on edge-based machine learning and agentic AI concepts for autonomous perception, adaptive analysis, and context-aware decision-making. The case study highlights the potential of multimodal data integration, including environmental sensor measurements and satellite imagery, for precision crop monitoring and agricultural management. The talk also discusses research challenges and future opportunities in energy-efficient intelligent sensing, hardware–software co-design, and autonomous AI-enabled agricultural ecosystems.

Keywords: Agentic AI, Edge Intelligence, Semiconductor-Enabled Smart Sensors, IoT, Autonomous Sensing Systems, Precision Agriculture, Remote Sensing and Machine Learning.

ICEMSET-2026/FS/INV/564

Engineering Functional Porous Materials and Nanocomposites for Sustainable Energy Applications

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Abstract

Functional porous materials and semiconductor nanocomposites offer tunable structures, surface properties, and chemical functionalities for sustainable energy conversion and environmental applications. This presentation will discuss the design, synthesis, and characterization of metal-organic frameworks (MOFs), zeolitic imidazolate frameworks (ZIFs), mesoporous silicas, and semiconductor-based nanocomposites, with emphasis on the relationships between structure, porosity, surface chemistry, and catalytic function. Examples will be drawn from our published work, including MOF-derived and graphitic carbon nitride-based nanocomposites for photo- and electrocatalytic H_2 production and porous adsorbents for CO_2 capture, and from selected literature. The discussion will also address key challenges in material stability, reproducibility, and the practical implementation of porous materials in sustainable energy technologies. The talk will conclude that controlling porosity, surface chemistry, and interfacial structure at the synthesis stage is central to designing porous materials with reliable performance in energy applications.

Keywords: Porous Materials; Metal-Organic Frameworks; Semiconductor Nanocomposites; Photocatalysis; Hydrogen Production.

ICEMSET-2026/FS/INV/565

Defect-Mediated Electronic and Optical Engineering of Cs_2SnI_6 Double Perovskites for High-Performance Photodetection: An Experimental and DFT Study

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Abstract

Cs_2SnI_6 double perovskites have attracted considerable interest as promising lead-free semiconductor materials for emerging optoelectronic applications. However, the influence of native defects on their electronic structure and optical behaviour remains an important area of investigation. This study explores the role of iodine vacancies in modifying the structural, electronic and optical properties of Cs_2SnI_6 through an integrated experimental and density functional theory (DFT) approach. Controlled defect engineering will be employed to examine changes in crystal structure, chemical composition, electronic states and optical absorption. Experimental characterization will include X-ray diffraction, X-ray photoelectron spectroscopy, UV–Visible spectroscopy and photoluminescence measurements. First-principles calculations using VASP will investigate defect formation energies, electronic band structures, density of states and optical properties. Furthermore, photodetector devices will be evaluated to understand the influence of defect concentration on charge transport and photoresponse. The findings are expected to provide insights into defect–property relationships and guide the development of efficient Cs_2SnI_6-based photodetectors.

Keywords: Cs_2SnI_6; Vacancy-Ordered Double Perovskites; Native Defects; Iodine Vacancies; First-Principles Calculations; VASP; Optical Properties; Photodetection.

ICEMSET-2026/FS/INV/566

Nanostructured carbons for lithium-ion batteries

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Abstract

Today, lithium-ion batteries are the canonical rechargeable power sources compatible with portable electronics, and have energy densities in excess of 200 Wh/kg. The most common anode material in these batteries is carbon, particularly graphitic carbons. However, the theoretical intercalation capacity of graphitic carbon is a poor 372 mAh/g (for a stoichiometry corresponding to LiC_6). A large number of nanostructured carbons have now been demonstrated to exhibit much higher capacities. However, many of them are unsuitable for practical applications, particularly in terms of their sloping discharge profiles and large first-cycle irreversible capacities. A class of carbons that stands out is kish graphite, a form of carbon precipitated from carbon-rich iron melts. Kish graphites can be derived from a variety of carbon-containing precursors including polymers. This opens a new route to synthesize a technologically useful product from an everyday waste. In this presentation, the production of kish graphite from polymeric waste is described, and their electrochemical characteristics as applicable to lithium-ion batteries are described. Specifically, capacities exceeding 450 mAh/g, flat discharge profiles and longevity are demonstrated.

Keywords: Kish graphite, Catalytic graphitization, Anode material, Lithium insertion, Carbon nanostructures.

ICEMSET-2026/FS/INV/567

Functional Polymer-based Separation Strategies for Remediation of Hazardous Effluents

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Abstract

The remediation of hazardous effluents containing radionuclides and toxic metal ions is a major challenge for environmental protection and sustainable nuclear energy utilisation. Conventional solvent extraction processes often encounter limitations related to phase separation, organic waste generation and operational complexity. Functional polymer-based materials offer promising alternatives through selective solid–liquid separation strategies. This lecture will highlight advances in polymeric membranes, polymer inclusion membranes, extractant-impregnated polymeric beads, graphene oxide-based nanocomposites and organo-functionalised mesoporous silica adsorbents. Particular emphasis will be placed on the synthesis, characterisation and application of functional polymeric beads for radionuclide separation. Experimental studies on PC-88A-encapsulated macroporous beads have demonstrated over 95% extraction of Pu(IV) from highly acidic low-level nuclear waste, with rapid extraction kinetics and good reusability. These approaches offer promising opportunities for developing selective, efficient and environmentally compatible technologies for hazardous effluent remediation.

ICEMSET-2026/FS/INV/568

Enhancing the Efficiency of PM6:Y6 Bulk-Heterojunction Organic Solar Cells through SCAPS Simulation Optimization

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Abstract

Organic solar cell (OSC) is becoming point of attraction in solar cell industry due to its benefits, such as light weight, flexibility, low cost, semi-transparency, easy fabricating methods. After the replacement of fullerene as acceptor with non-fullerene acceptors like Y6, ITIC, PCBM, ICBA; Power conversion efficiency (PCE) of OSCs has reached over 15 % benchmark. Here, the proposed structure of OSC is ITO (Front contact electrode)/SnO2 (ETL)/PM6:Y6 (active layer)/Cu2O (HTL)/Ag (Back contact electrode). The device improvement analysis has been carried out in steps by analysing the ETL-HTL effect, by selecting optimum thickness of active layer, and optimum value of defect density. In the first step, PCE achieved was 24.60%, followed by an improvement to 27.55% with the optimized defect density value. The best PCE achieved was 27.74% in the third step with an optimized active layer thickness, leading to high fill factor (80.56%), open-circuit voltage (0.9461 V), and short-circuit current density (36.188 mA/cm2). Systematic numerical simulation of above proposed OSC has been performed using Solar cell capacitance simulator (SCAPS)-1D.

Keywords: Organic solar cell; Bulk-heterojunction; Power conversion efficiency; Electron transport layer; Hole transport layer.

ICEMSET-2026/FS/INV/569

Design and Development of a Drone-Based Electronic Feed Dispersal System for Precision Aquaculture

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Abstract

Aquaculture plays a vital role in food security. However, feed management remains a challenge, accounting for 60% of production costs. Conventional manual feeding is labour-intensive, time-consuming, and often causes non-uniform feed distribution. This paper presents a drone-based feed dispersal system designed to improve the efficiency and consistency of aquaculture feeding. The system integrates an unmanned aerial vehicle (UAV) with electronic flight control, brushless DC (BLDC) propulsion, electronic speed controllers (ESCs), battery power management, and an electrically actuated dispensing mechanism. Its control architecture coordinates propulsion and feed release during flight, supporting uniform distribution over ponds while reducing manual intervention and operating time. A prototype has been developed and field-validated. Demonstrations and user feedback indicate its potential to improve feeding convenience, reduce labour dependency, and enhance

operational efficiency. The platform demonstrates emerging electronics, embedded control, UAV technology, and electromechanical integration for sustainable aquaculture, providing a foundation for scalable and cost-effective precision-feeding solutions.

Keywords: Aquaculture; Feed Dispersal Drone; UAV; Embedded Electronics; Precision Feeding: Electromechanical Systems.

ICEMSET-2026/FS/INV/570

The integration of Artificial Intelligence (AI) and computational techniques

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Abstract

The integration of Artificial Intelligence (AI) and computational techniques is transforming advanced materials science and semiconductor research. This talk explores the applications of Machine Learning, Deep Learning, Data Mining and computational intelligence in material characterization, defect detection, microstructural analysis and performance prediction. It highlights how AI-based approaches can identify structural abnormalities, analyse material properties and predict potential failures in metals, polymers, ceramics and semiconductor materials. The talk also introduces forensic materials science, focusing on the computational investigation of material failures, fracture patterns, glass fragments, paint layers and other material evidence. Practical examples will demonstrate the potential of intelligent analytical techniques in industrial quality assessment, semiconductor reliability and forensic investigations. Finally, emerging research opportunities and challenges in integrating Computer Science, Artificial Intelligence, Physics and Materials Engineering will be discussed.

Keywords: Artificial Intelligence; Machine Learning; Computational Materials Science; Semiconductor Defect Detection; Forensic Materials Analysis.

ICEMSET-2026/FS/INV/571

Evaluation of the Combined Wound Healing Potential of Hemin and Bilirubin Nanoparticles through Multimodal Characterization and Integrated Molecular Investigations in Streptozotocin-Induced Diabetic Rats

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Abstract

Diabetic wound healing is impaired by oxidative stress, inflammation, and compromised tissue regeneration. This study evaluated the combined topical efficacy of hemin nanoparticles (HNP) and bilirubin nanoparticles (BNP) in streptozotocin-induced diabetic rats. Both formulations were synthesized by ionic gelation using chitosan and tripolyphosphate (TPP) and characterized by DLS, FTIR, XRD, SEM, TEM, DSC, and Raman spectroscopy. Selected concentrations of HNP (0.5%) and BNP (0.1%), based on individual wound-healing evaluations, were combined and topically applied, with Pluronic F-127 as vehicle control. Wound contraction, biochemical parameters, gelatin zymography, Western blotting, and histopathology were assessed. Both

formulations exhibited 100–200 nm particle sizes and positive surface charges. Combined treatment accelerated wound closure, achieving near-complete healing by day 16, reduced TNF-α, MMP-2, and MMP-9, and increased IL-10, α-SMA, TGF-β1, Nrf2, and HO-1. Histopathology revealed improved epithelialization and collagen deposition. Network pharmacology and KEGG enrichment highlighted TNF and HIF-1 signaling pathways.

Keywords: Hemin nanoparticles; bilirubin nanoparticles; diabetic wound healing; nanoparticle characterization; network pharmacology.

ICEMSET-2026/FS/INV/572

Next-Generation Hydrogen Storage Nanomaterials: Mechanisms, Design Strategies, and Future Perspectives

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Abstract

Multicomponent alloys have emerged as promising materials for solid-state hydrogen storage owing to their compositional flexibility, tunable lattice structures, multiple hydrogen absorption sites and potential for enhanced hydrogen-storage performance. Their elemental composition nature offers opportunities to tailor hydrogen absorption/desorption thermodynamics and kinetics through controlled elemental selection and compositional engineering. This contribution explores the fundamental mechanisms of hydrogen interaction with HEAs, including interstitial hydrogen accommodation, hydride formation and diffusion pathways. Particular emphasis is placed on the influence of alloy composition, crystal structure, lattice distortion and microstructural characteristics on hydrogen-storage capacity, reversibility and cycling stability. Recent advances in representative transition-metal-based HEA systems are discussed, highlighting the challenges associated with hydrogen-storage capacity, activation behaviour, operating temperature and long-term stability. Finally, emerging design strategies and future research directions are outlined towards developing efficient, durable and sustainable HEA-based hydrogen-storage materials.

Keywords: Hydrogen storage; Metal hydrides; Hydrogen absorption/desorption; Solid-state hydrogen storage.

ICEMSET-2026/FS/INV/573

Exploring the Molecular Basis of Diacerein Repurposing for Diabetes Mellitus Using Network Pharmacology and Molecular Docking

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Abstract

Diacerein, an established anti-inflammatory agent, may offer therapeutic potential in diabetes mellitus through modulation of multiple molecular targets. This study investigated its potential antidiabetic mechanisms using integrated network pharmacology and molecular docking. Diabetes-associated targets were retrieved from GeneCards, OMIM, and Open Targets, while diacerein targets were predicted using SwissTargetPrediction, TargetNet, and the Similarity Ensemble Approach. Of 1,876 diabetes-associated and 191 diacerein-associated targets, 84 common targets were identified. STRING-based protein–protein interaction analysis and five cytoHubba algorithms identified nine consensus hub genes: BCL2, CASP3, MDM2, ESR1, PARP1, HSP90AA1, GSK3B, RELA, and PPARG. Gene Ontology and KEGG analyses highlighted pathways associated with apoptosis, inflammation, lipid metabolism, and diabetic complications. AutoDock Vina 1.2.7 predicted binding affinities of −7.3, −8.4, and −8.7 kcal/mol for GSK3β, PPARγ, and PARP1, respectively. Complexes were visualized using PyMOL and Discovery Studio. These findings suggest that diacerein may modulate diabetes-associated molecular networks, warranting further mechanistic and experimental investigation.

Keywords: Diacerein; Diabetes mellitus; Network pharmacology; Molecular docking; Drug repurposing.

ICEMSET-2026/FS/INV/574

Mapping the Molecular Landscape of 77PD-Quinone-Associated Endothelial-to-Mesenchymal Transition and Blood–Brain Barrier Dysfunction through Network Toxicology and Molecular Docking

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Abstract

Endothelial-to-mesenchymal transition (EndMT) contributes to vascular dysfunction and blood–brain barrier (BBB) impairment. 77PD-Quinone (77PD-Q), an emerging environmental contaminant associated with rubber antioxidant use, has been detected in fine particulate matter. This study investigated its potential molecular association with EndMT and BBB dysfunction through integrated network toxicology and molecular docking. EndMT-associated targets were retrieved from GeneCards, while 77PD-Q targets were predicted using SwissTargetPrediction, PharmMapper and PASS Targets. Intersection analysis identified 274 common targets. STRING and Cytoscape analyses identified 12 hub targets shared across five topological algorithms. Gene Ontology enrichment highlighted cell migration, extracellular matrix remodelling, oxidative stress and inflammatory processes, while KEGG analysis revealed MAPK, PI3K–Akt, TNF, IL-17 and HIF-1 signalling pathways. Molecular docking against MMP9, SRC, EGFR, AKT1 and STAT3 yielded binding scores ranging from −6.4 to −11.5 kcal/mol. These findings provide molecular insights into the potential involvement of 77PD-Q in EndMT-associated endothelial dysfunction and BBB impairment.

Keywords: 77PD-Quinone; Endothelial-to-mesenchymal transition; Blood–brain barrier; Network toxicology; Molecular docking.

ICEMSET-2026/FS/INV/575

Rice Husk-Derived Sustainable Functional Materials: Opportunities for AI-Driven Property Prediction and Electronic Applications

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Abstract

Rice husk as an inexpensive waste product of agriculture is considered to be promising renewable resource for sustainable functional materials. In connection with composition of rice husk made of silicon and carbon, the use of rice husk in electronics, thermics and energy materials becomes possible. On the basis of the present stage of research regarding rice husk utilization, the presented project suggests the concept of computational framework that utilizes artificial intelligence technologies in order to investigate potential application of rice husk-based materials. The experimental data concerning compositions of materials, process parameters, structure and functional properties of these materials, which are presented in scientific literature, will be gathered and investigated. Machine learning algorithms will be used for determination of dependencies between process parameters and material properties, and explainable artificial intelligence can be used for the selection of the most significant material properties. Consistency check of the obtained dependencies will be performed. The proposed computational framework aims to develop the data-driven way of investigation of sustainable materials, their selection and possible process routes.

Keywords: Rice Husk, Artificial Intelligence, Machine Learning, Computational Materials Science, Physics-Informed Learning, Silica-Based Materials.

ICEMSET-2026/FS/INV/576

Emergency Data Exchange System in Network Blackouts and Disaster Zones

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Abstract

Modern communication relies heavily on centralized internet and cellular networks, which often fail during natural disasters, large gatherings, military operations, and infrastructure breakdowns. These outages create severe safety risks, highlighting the urgent need for a reliable, low-cost, and self-contained communication system that operates independently of external networks. To solve this, a digital file transfer system was developed using Software Defined Radio (SDR) technology. Implemented with ADALM-Pluto SDR hardware and open-source GNU Radio Companion software, the system transmits data directly over radio waves without internet or cellular connectivity. It works reliably even in noisy environments and offers flexible control over transmission frequency range. The System is capable of encoding and transferring text, images, voice, sensor data, and documents, this setup enables essential real-time communication between PlutoSDR units. It serves as an affordable, highly adaptable solution for remote locations, emergency response, and tactical operations when regular networks are unavailable.

Keywords: Communication, GNU Radio, Pluto SDR, File transfer, Disasters.

ICEMSET-2026/FS/INV/578

AI-Powered Smart Metering Network Sensor: Edge Intelligence for Prediction, Theft Recognition, and Load Disseminate

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Abstract

The majority of analytics are left to the cloud by conventional smart meters, which record voltage and current and report cumulative energy at predetermined intervals. In order to enable the meter itself to disaggregate appliance loads, detect irregular usage (including theft and tampering), and estimate short-term demand, this study offers an AI-based sensor node that embeds a lightweight neural network adjacent to the metering front end. The node uses a low-power microcontroller to run a quantized temporal convolutional network (TCN), extract electrical features, and sample voltage and current at 4 kHz. The suggested model achieves an F1-score of 0.89 for appliance-state detection, 0.92 for theft detection, and a forecasting MAPE of 4.3% in a reference simulation exercise; int8 quantization reduces inference latency from 41 ms to 9 ms with a loss of 0.01 in F1. Because just events and summaries are sent, the architecture reduces uplink traffic by around 85%. Note: Before submitting, you must substitute your actual measured data with the numerical findings in this draft, which are illustrative values for a reference implementation.

Keywords: smart meter, AI sensor, edge computing, NILM, theft detection, load forecasting.

ICEMSET-2026/FS/INV/579

Protein–Protein Interactions Guided Green Synthesis of Gold Nanoparticles: Mechanistic Insights and Biomedical Applications

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Abstract

Protein–protein interactions (PPIs) offer transformative opportunities for developing functional nanomaterials with potential biomedical applications. In this study, we explore the green synthesis of protein-functionalized

gold nanoparticles (AuNPs) employing binary protein complexes, especially lysozyme–cytochrome c and lysozyme–zein systems. Bioconjugated AuNPs were prepared through an *in vitro* approach by incubating protein mixtures with $HAuCl_4$ under controlled conditions. The resulting bioconjugated AuNPs were characterized employing UV–Visible and fluorescence spectroscopy, gel electrophoresis, transmission electron microscopy, and molecular dynamics simulations. The findings reveal that PPIs significantly influence nanoparticle surface organization, stability, and pH responsiveness. Moreover, the functionalized AuNPs demonstrated promising antimicrobial activity against selected fungal pathogens (e.g., *Geotrichum Candidum, Aspergillus niger, Candida albicans*, and *Candida tropicalis*) and favorable hemocompatibility at appropriate compositions. These findings highlight the potential of protein-mediated green synthesis for developing multifunctional nanomaterials for future biomedical applications, including antimicrobial formulations and drug delivery systems.

ICEMSET-2026/FS/INV/580

For Powering Future Electronics in Mega scale, an Emerging Technology of Locally Generating Hydroelectricity Using Recycling Brackish Water Without External Energy

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Abstract

Six Scientific Principles:

1. Enhanced Cloud Formation in Room Temperature at Partial Vapour Pressure within confined volume.
2. Cloud Rising by Buoyancy Lift to Higher Elevation within confined volume.
3. Artificial Raining using Standard Mist Separator Technology within Confined Volume being used in Nuclear Power Plants.
4. Gravity Downward Flow of this Artificially Rained Water through Hydro turbine generating Hydroelectricity for Powering Future Extra Large Capacity Electronic Packages.
5. Sustaining the Partial Vapour Pressure by Pumping Action of the downward flow of Artificial Rain Water
6. Using the Byproduct of Distilled Potable Water for Cooling the Future Electronic Packages

Our Vision for Project

- Bountiful of Potable Water with Ground Water Table Lift
- Self-sustaining process without requiring any external power
- Generation of Hydro Electricity

Project Summary

The proposed project uses multiple natural phenomena, self-propelling, (as described below) for generation of unlimited Hydroelectricity and potable distilled water, thus, giving energy and water security for future generations of electronics for all the time to come.

Background - Phenomena of Cloud Formation and Raining in Nature

In nature, the Sun's heat evaporates water into "cloud droplets" of about 2 microns diameter. These droplets collide with each other and continue to grow into lighter and bigger droplets. This results in buoyancy-rise of clouds in open sky. During this process droplets collision continues till its diameter reaches about 30 microns and above. Beyond this, the cloud cannot sustain as droplets and results in precipitation and raining.

Physics Concepts

Above background processes are known since many years in Tropical Meteorology. Our team see this as natural phenomena. We industrialise it in nationwide scale as enumerated below:

- Barometric head is 1,000 millibar/10.33meter water column.
- Upwards rising of clouds at foothills is common sight.
- In one-meter-long glass tube, vacuum is seen above barometric column of 760 milli meter of Mercury, as experienced in Science Laboratories in Schools and Colleges.
- For water, it is measured as 20 milli bar partial pressure on evaporation of water at 17.5°C.

- Mist collection process by using diverter vanes widely employed in Industries since beginning of Steam Turbines in Power Plants. It is analogues to raining.
- Rain Precipitation under turbulence is seen in nature and also experimentally reproduced in laboratories, including Indian Institute of Tropical Meteorology, Pune, India.

Natural Phenomena Used and Working Methodology

1. Water is lifted by barometric head, up to the Cloud Formation Chambers; wherein it boils at partial vapour pressure (20 milli bar: 17.50 C) to form clouds.
2. These boiling takes place up to about 200 mm depth (being below partial vapour pressure) containing millions of molecular layers: each layer boiling and forming clouds. Thus, each m2 area represents 100s of square km of water body forming clouds.
3. Cloud rises to higher elevations by buoyancy into the Rain Harvester Housing creating potential energy and rains by Nucleation while passing through mist panels.
4. Rain water flows down to distribution chamber by a barometric head by producing Hydroelectricity and also creating vacuum in Rain Enhancement Chamber: which spreads all the way to Cloud Formation Chambers.
5. Further, this vacuum helps in evaporating the sea water at room temperature (depth of about 200 mm) and formation of rain clouds at enhanced rate and bountiful quantity.
6. Higher elevations of Distribution Chamber provide natural Gravity Distribution.
7. De-aerated water (distillate) gets remixed with air for achieving potability.
8. Initial starting vacuum is obtained by "Natural Gravity Flow" of built-in priming water. This water is replenished automatically soon after, without any uncertainty-by design.
9. Generation of raw material for highly valuable Lithium and Sodium as by-products wherever available.

Major Advantages

- Extraction of sea minerals 24×7×365 in mega quantities up to 100 Billion Tonnes/1000 Plants/100 years if installed near sea shore.
- Elevating Groundwater Table.
- Perennial cloud formation in confined volume without thermal energy inputs.
- Raining the cloud completely within another confined volume at additional higher elevation for gravity distribution and electricity generation.
- Circumventing brine problem with nil discharge with valuable minerals as by product.
- Unlimited and perennial Hydroelectricity and potable water for Future Electronics, along with domestic, commercial, industrial uses and elevating ground water table at a negligible cost.
- Since entire process is taking place in a confined volume, it is independent of any climate change.

ICEMSET-2026/FS/INV/581

Multiband Tunable Metamaterial Absorber Based on Vanadium Dioxide for Mid-Infrared Refractive Index Sensing application

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Abstract

We present a compact and tunable multiband metamaterial absorber (MMA) for mid-infrared refractive index sensing applications. The proposed structure consists of a two-dimensional periodic array of vanadium dioxide (VO_2) circular discs integrated with a dielectric spacer (refractive index = 1.65) and a continuous silver (Ag) ground plane. An alternative multilayer configuration incorporating a VO_2-based layer on a metallic film is also investigated. The electromagnetic response is analyzed using the finite element method (FEM) implemented in COMSOL Multiphysics. Numerical results demonstrate distinct multiband absorption peaks in the mid-infrared region, exhibiting tunability through the temperature-dependent insulator-to-metal phase transition of VO_2. The underlying absorption mechanisms are investigated through electric and magnetic field distributions, revealing localized electromagnetic, vertical cavity mode, and dipolar resonances. The influences of geometrical parameters and incident angle on the absorption characteristics are systematically examined. Furthermore, refractive index sensing performance is evaluated by varying the refractive index of the surrounding medium in both insulating and metallic phases of VO_2. The proposed design offers a promising platform for tunable multiband mid-infrared sensing and advanced infrared photonic applications.

Keywords: Metamaterial absorber; Vanadium dioxide; Phase-change materials; Multiband absorption; Refractive index sensing; Mid-infrared photonics.

ICEMSET-2026/FS/INV/583

Phytohormonal Responses and Growth Performance of Six Plant Species in NFT-Based Wastewater Phytoremediation

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Abstract

Phytohormonal regulation plays an important role in plant growth and physiological adaptation during wastewater phytoremediation. This study investigated auxin, gibberellin and cytokinin responses in six plant species (Money Plant, Crotons, Arrowhead, Brinjal, Vetiver and Spinach) cultivated in Nutrient Film Technique (NFT) systems under indoor and outdoor conditions. Plants were exposed to simulated wastewater containing nitrate concentrations of 30–120 mg/L and aquaculture wastewater for 30 days. Hormone levels were determined using spectrophotometric assays, alongside plant growth and wastewater quality assessments. At lower nitrate concentrations, all six species exhibited increased auxin levels, with Money Plant and Spinach showing comparatively higher increases. Gibberellin and cytokinin also showed species-dependent responses, while higher nitrate concentrations resulted in varying hormonal changes among the species. The findings highlight differences in plant physiological adaptation and provide insights into the potential application of hydroponic plant species for sustainable wastewater phytoremediation.

Keywords: Auxin; Gibberellin; Cytokinin; Nutrient Film Technique; Phytoremediation; Wastewater Treatment.

ICEMSET-2026/FS/INV/584

Numerical Analysis of Type-VI Shock-Shock Interactions for Different Gas Types Using OpenFOAM

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Abstract

This study presents a high-fidelity computational investigation of Type-VI shock-shock interactions in supersonic flow over a double-wedge geometry using the open-source OpenFOAM framework. The analysis aims to elucidate how gas-specific thermodynamic properties influence complex shock interactions and the resulting aerodynamic loads. Simulations are performed using the verified dbnsFOAM solver with a high-resolution numerical scheme to ensure accuracy and stability. The computational framework is validated against analytical solutions, and grid independence is established to ensure the reliability of the numerical results. A comparative analysis of monatomic argon and diatomic air reveals significant differences in shock structures and flow-field characteristics due to variations in the specific heat ratio (y). Argon exhibits stronger shock waves with larger wave angles, leading to substantially higher surface pressures and stagnation temperatures than air. The findings demonstrate the critical role of gas thermodynamic properties in governing shock-shock interactions and aerodynamic heating. This investigation provides valuable insights into gas-dependent shock dynamics and highlights the importance of accurate gas modeling for predicting pressure loads and thermal effects in hypersonic vehicle design.

Keywords: Double-wedge; Type-VI; OpenFOAM.

ICEMSET-2026/FS/INV/585

Significance of UV(Ultra-Violet) Lighting in modern times

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Abstract

UV-rays are known to posses' harmful effects on the human skin and considered relatively, dangerous for all forms of life as well, on earth. However, in modern times man has realized the importance and acknowledged the presence of UV-radiation in our environment. Challenging the conventional beliefs, now UV has become a main part of our daily life as such used in air/water purifiers, surface disinfectants etc due to its very germicidal affects. This therefore, has evolved into the development of new artificial UV-light sources. Today UV-emissions offer numerous applications ranging from bio-medical, agricultural to anti-counterfeiting, as potential sectors. Thus, old mercury-based UV-sources are getting replaced by much efficient light-emitting diode (LED) solid state devices. Many UV-A sources are available commercially but sources emitting in shorter wavelengths for e.g. in deep UV-C ranges are still difficult to produce economically. Therefore, it's a call to advance the still existing technologies.

Keywords: Ultraviolet, UV rays, LED, solid state, light sources.

ICEMSET-2026/FS/INV/586

Managing aI Adoption in Advanced Materials Manufacturing: Organisational Readiness, Implementation Challenges, and Strategic Opportunities

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Abstract

Artificial intelligence (AI) is increasingly applied to materials discovery, process optimisation, quality assurance, predictive maintenance, energy management, and product development. However, technical feasibility does not guarantee successful industrial adoption. This paper examines AI adoption in advanced materials manufacturing as a staged organisational capability rather than as an isolated software or modelling problem. Drawing on research across manufacturing, materials informatics, additive manufacturing, digital twins, sustainability, and responsible innovation, the paper synthesises evidence around four themes: organisational readiness, technical applications, implementation challenges, and performance opportunities. The findings indicate that adoption depends on the interaction of technological infrastructure, organisational resources, leadership, workforce capability, data governance, external support, and human–AI collaboration. Although technical studies demonstrate substantial potential, industrial deployment remains constrained by heterogeneous data, limited reproducibility, interoperability problems, distribution shift, legacy systems, cybersecurity risks, weak explainability, and uncertain business cases. This paper proposes a staged adoption roadmap comprising readiness diagnosis, bounded pilot selection, capability development, evidence-based scaling, and enterprise integration. The paper argues that advanced materials manufacturers should evaluate AI not only through predictive accuracy but also through operational performance, sustainability, human oversight, reproducibility, and responsible value creation.

Keywords: Artificial intelligence; advanced materials manufacturing; additive manufacturing; organisational readiness; machine learning; digital twins; responsible innovation; sustainable manufacturing.

ICEMSET-2026/FS/INV/587

Integrating Remote Sensing and Plantation Data for Oil Palm Yield Estimation Using Random Forest Regression

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Abstract

Oil palm yield assessment requires understanding how environmental and plantation factors relate to productivity, yet their block-specific associations and combined predictive performance require further evaluation. This study investigates relationships between monthly oil palm yield and four predictors: Normalized Difference Vegetation Index (NDVI), land surface temperature (LST), rainfall, and palm age. Data from seven plantation blocks covering May 2021 to December 2023 yielded 224 block-month observations. Spearman correlation analysis was conducted separately for each block, followed by Random Forest regression using an 80:20 training-testing split and five-fold cross-validation. Palm age exhibited the strongest absolute correlation with yield in six blocks, while NDVI was dominant in one block. The Random Forest model achieved a mean cross-validation R^2 of 0.551 and test R^2 of 0.680, with RMSE of 0.264 t/ha and MAE of 0.202 t/ha. These findings highlight block-specific relationships and the potential of integrated predictors for retrospective yield estimation.

Keywords: Oil Palm Yield Estimation; Remote Sensing; Plantation Data; Random Forest Regression; Spearman Correlation.

ICEMSET-2026/FS/INV/588

From Industrial Waste to Circular Innovation: Fly Ash Cenospheres-Reinforced Sustainable Polymer Composites

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Abstract

The growing environmental problems caused by plastic waste, resource exhaustion and industrial by-products have increased the need for sustainable materials based on circular economy principles. Fly ash cenospheres are attractive as a reinforcing material for polymer composites due to their hollow spherical shape, low density, thermal stability and unique surface properties. In this paper, we discuss the development of sustainable cenosphere-reinforced polymer composites using fillers derived from industrial waste and recycled or bio-based polymer matrices. The growing environmental concerns related to plastic waste, resource depletion and industrial by-products have led to demand for sustainable materials in line with the circular economy principles. Fly ash cenospheres are desirable as a reinforcing material for polymer composites because of their hollow spherical shape, low density, thermal stability and unique surface properties. This paper reports on the development of sustainable cenosphere-reinforced polymer composites using fillers from industrial waste and recycled or bio-based polymer matrices.

Keywords: Fly ash cenospheres, Sustainable polymer composites, Circular economy, Waste valorisation, Recycled polymers.

ICEMSET-2026/FS/INV/589

Fly Ash-Based Zeolites: Synthesis, Reliability and Applications in Wastewater Treatment

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Abstract

Fly ash, a major industrial waste generated from coal-based thermal power plants, has considerable potential as a low-cost raw material for the synthesis of zeolitic materials. The present work focuses on the hydrothermal synthesis of fly ash-based zeolites and their structural, morphological, and physicochemical characteristics. The reliability and performance of these materials are governed by their crystallinity, porosity, chemical stability, and adsorption properties. Owing to their unique porous structure, high surface area, and excellent ion-exchange capacity, fly ash-derived zeolites offer promising applications in wastewater treatment. Furthermore, converting fly ash into value-added zeolitic materials provides an environmentally sustainable approach to industrial waste

utilization, resource recovery, and pollution control. These materials hold significant potential for future applications in sustainable water purification technologies.

Keywords: Fly ash, Zeolites, Hydrothermal synthesis, Industrial material reliability, , Wastewater treatment, Sustainable materials.

ICEMSET-2026/FS/INV/590

Fiber Gratings

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Abstract
The periodic modulation of the refractive index in the propagation direction is an efficient design of an optical fiber to manipulate the light. When the period of the modulation is few micron i.e. in fiber Bragg grating there is a dip in the transmission spectrum by coupling power from forward propagation mode to the backward propagation mode of the structures. When the period of modulation is few hundreds of micron in long period gratings there are resonant dips in transmission spectrum by coupling power from core mode to the co-propagating cladding modes. These dips are governed by the grating period and refractive indices of core and cladding, for minute changes there is a shift in the resonant wavelengths which enables gratings to sense the quantity of interest such as strain, temperature and refractive index. The design and analysis is of these grating structure is of interest in this paper.

Keywords: fiber Bragg gratings, long period gratings.

ICEMSET-2026/FS/INV/591

Development of environment friendly blends of Polylactic Acid

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Abstract
PLA is expensive as compared with other conventional petroleum-based polymers. Hence, in order to reduce the cost of processing materials, starch has been commonly, as it is a renewable based raw material, which is biodegradable, abundantly available and inexpensive. Many studies have been carried out in the area of PLA/starch blends to reduce the production cost and improve its biodegradability. Furthermore, to enable the melt mixing of starch with polymer, it has been suitably thermoplasticized to Thermoplastic starch (TPS), as pure starch has a melting temperature of around 220-240ºC, which is close to its degradation temperature. Commonly employed plasticizers for modification of starch includes polyols such as sorbitol and glycerol as they are generally similar to the structure of the polymer they plasticize. TPS is generally prepared by mixing starch and plasticizers (e.g. glycerol and/or water) by thermo-mechanical treatment resulting in a disruption of granular starch structure. More often the properties obtained for the PLA/starch blends are not satisfactory due to immiscibility between hydrophilic starch and hydrophobic PLA. Therefore, to enhance the interfacial adhesion between PLA and TPS, plasticizers like ESO were intended to initiate chemical bonds between PLA and TPS molecules. ESO due to its non-toxic has been utilized to decrease water absorption. ESO also acts as a plasticizer in many polymeric systems, which is predominantly due to the presence of polar groups that enhances the mechanical properties, essential for improved compatibility. In this study, a novel approach for improving the compatibility between starch and PLA is considered via modification of starch using ESO. Further, the blend of PLA with TPS has been prepared employing melt blending technique. A comparative aspect of the properties of PLA blends with TPS and modified TPS; using ESO has been investigated. An in-depth analysis of mechanical, morphological, and degradation characteristics of PLA and its blends has been studied.

ICEMSET-2026/FS/INV/593

Tuned Nanoporous Phosphorene Membrane for Efficient Water Desalination Performance

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Abstract

Freshwater scarcity has accelerated the search for highly efficient membrane-based desalination technologies. Phosphorene has emerged as a promising two-dimensional membrane material because of its self-passivation, stability, and excellent water transport characteristics. Here, desalination performance of nanoporous phosphorene membranes with different pore sizes and electrostatic charge distributions using molecular dynamics simulations is reported. The results demonstrate that pore size and surface charge play a crucial role in regulating water transport through the membrane. An optimally sized nanopore with moderate edge charge exhibited the highest water permeability while simultaneously achieving excellent salt rejection. Increasing the edge charge density enhanced electrostatic interactions between the membrane and hydrated ions, effectively suppressing ion transport but also reducing water flux due to stronger interactions with water molecules. Analysis of water density distributions, radial distribution functions, and ion transport behavior revealed that the interplay between steric confinement and electrostatic effects governs the selective transport mechanism. The charged phosphorene membrane maintained high desalination efficiency even under high salinity conditions, highlighting its robustness for practical applications. These findings show that by optimizing nanopore geometry and charge distribution offers an effective strategy for balancing water permeability and salt rejection, thereby advancing the development of energy-efficient desalination technologies for sustainable freshwater production.

Keywords: Molecular dynamics, Desalination, Charged nanopores, Phosphorene.

ICEMSET-2026/FS/INV/594

Ancient Indian Metallurgical Knowledge and Its Relevance to Modern Materials Science

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Abstract

Ancient Indian metallurgy represents a remarkable tradition of scientific and technological advancement in metal extraction, processing, alloying, and material engineering. Achievements such as the corrosion-resistant Delhi Iron Pillar, high-carbon Wootz steel, and advanced zinc distillation at Zawar demonstrate the sophisticated metallurgical knowledge of ancient Indian craftsmen. This study examines these contributions and their relevance to modern materials science, focusing on metal production, alloy development, microstructural control, heat treatment, and corrosion resistance. It explores how traditional processing techniques influenced the structure, properties, and performance of metals, connecting historical practices with modern concepts such as phase transformations, materials characterization, surface engineering, and process optimization. Furthermore, the study highlights the potential of indigenous metallurgical knowledge to inspire sustainable, resource-efficient, and environmentally responsible manufacturing processes. It emphasizes that ancient Indian metallurgy is not merely a historical achievement but also a valuable source of scientific understanding, innovation, and inspiration for contemporary materials research and technological development.

Keywords: Ancient Indian metallurgy, Wootz steel, Delhi Iron Pillar, Zinc distillation, Corrosion resistance, Traditional materials science, Sustainable metallurgy.

ICEMSET-2026/FS/INV/595

Ficus racemosa as green inhibitor of mild steel corrosion in sulphuric acid medium

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Abstract

The inhibition effect of 500 ppm concentration of Ficus racemosa (FR) fruit extract on corrosion of mild steel in 1N sulphuric acid was studied at various temperatures (range 298 K - 328 K). Electrochemical studies indicate that the extract displayed excellent inhibition efficiency of 98.85% at 298 K which decreased with increase in temperature. Surface morphological studies like SEM and AFM corroborated with these findings and depicted improvement of the corroded mild steel surface in the presence of inhibitor. GCMS analysis of inhibitor extract revealed presence of complex phytochemical components. Their synergistic effect played an important role in the effective inhibition.

Keywords: Ficus racemosa, GCMS, SEM, AFM, Mild steel, Electrochemical studies.

ICEMSET-2026/FS/INV/597

Smart Agriculture

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Abstract

Agriculture is still the main economic activity for food crop production in India. But the traditional ways of farming are unable to meet food requirement of the most populated country of the world. Therefore, it has become imperative to do the agriculture smartly which will enhance the earning of farmers along with saving time, effort and money. So smart agriculture is an agriculture in which crop production is done in a smart way reducing cost, time and getting maximum production from fields with the use of modern inputs and technology. The main focus in this agriculture is on maintaining air and water quality by preserving environment and resources. Science and technology are immensely helpful in such type of agriculture by providing mechanical and electrical devices. Thus, smart agriculture is aimed at boosting production, meet food requirement, increase cropping intensity and save environment. It maximizes profit by making use of modern technological benefits such as submersible pump for irrigation, computerized levelling for water and energy saving and installation of solar plates to promote sustainable development in agriculture.

Keywords: Smart Agriculture, Environment, Resources, Science and Technology.

ICEMSET-2026/FS/INV/599

III-nitride semiconductors: Emerging Applications and challenges

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Abstract

Since transistor demonstrated successfully, semiconductors become a significant part for many electronic applications, such as defense, high-seed communications, renewable energy, medical devices, automobile and display. However, the conventional semiconductor based electronic have almost reached their maximum power capability, operating temperature and conversion efficiency. Hence, it is an important to introduction of new semiconductor materials to fulfill future needs. From the beginning of III-nitride compound semiconductor materials has manifested for various modern applications because of their inherent properties such as direct band gap, high electron mobility and high breakdown field. Therefore, semiconductor belonging to this group are the most prominent for emerging technologies including power electronics, renewable energy, automotive, photonics, Communication and Aerospace. However, a reverse leakage current due to unintentionally added crystal defects such as point defects (Si interstial, N-vacancy) dislocations act as deep level defects in the material systems during their growth time or at processing is remain a big challenge. In this talk, along with

opportunities involved in power, opto-electronic and sensor applications of the III-nitride materials I will demonstrate on method to identify the electronic deep raps (deep level defects) in GaN and InGaN/GaN (single and double) quantum well LED and explore the possible reverse leakage current mechanism via defect states in GaN Schottky devices.

Keywords: Semiconductors; GaN; Schottky diodes; LEDs; DLTS.

ICEMSET-2026/FS/INV/600

Catalyzing the Circular Economy: From Molecular Design to Functional Sustainable Materials

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Abstract

Traditional plastics demand a shift toward a circular materials economy. We can bridge this gap by designing sustainable polymers and bio-composites that pair molecular innovation with real-world applications. This lecture focuses on synthesizing polymer architectures from bio-based feedstocks and engineered natural fibers. We explore how tailoring functional groups and introducing dynamic covalent chemistries—like vitrimers—allows us to create high-performance composites for the automotive, packaging, and electronics sectors. Crucially, these advanced matrices enable on-demand disassembly, self-healing, and closed-loop chemical recycling back to pristine monomers. By aligning targeted chemical synthesis with practical performance and scalable end-of-life reclamation, we can transform hazardous plastic waste streams into high-value technological assets.

Keywords: Bio-based synthesis, Dynamic covalent networks, Functional bio-composites, Closed-loop recycling, Macromolecular design, Advanced material applications.

ICEMSET-2026/FS/INV/601

Tailoring the optical and dielectric properties of ZnO nanoparticles through nitrogen and zirconium co-doping

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Abstract

In the present work, nitrogen (N) and zirconium (Zr) dual doped ZnO nanoparticles were prepared by using co-precipitation method. The structural and morphology of ZnO was investigated through X-ray diffraction (XRD), Fourier transform spectroscopy (FTIR) and electron microscope. XRD analysis revealed that modification in ZnO crystallography indicating the variation of lattice parameters and decrease in crystallite size due to incorporation of dopants. The microstructural analysis showed a decrease in the particle size without a significant morphological change. UV Vis studies demonstrated a systematic modification in the absorption behaviour and decrease in the bandgap attributed to defects related and intermediate states. Dielectric behaviour demonstrates a remarkable change in dielectric constant, loss, and ac conductivity indicating improved polarization mechanisms associated with interfacial effects, defects, and charge carrier's mobility. The dual doping of N and Zr offer better control over the structural and morphological of ZnO nanoparticles that elucidates the role of dopant engineering in developing it as multifunctional material.

Keywords: N, Zr co-doped ZnO; XRD: Electron microscope; Optical and Dielectric response.

ICEMSET-2026/FS/INV/602

Synergistic Engineering of $NiWO_4$-rGO and $CoWO_4$ -rGO Nanocomposites for High-Performance Supercapacitor

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Abstract

The development of advanced electrode materials with enhanced electrochemical properties has attracted considerable attention for next-generation supercapacitor applications. Transition-metal tungstates, particularly nickel tungstate ($NiWO_4$) and cobalt tungstate ($CoWO_4$), have emerged as promising electrode materials owing to their unique crystal structures, multiple oxidation states, electrochemical activity, and chemical stability. However, their relatively poor electrical conductivity and limited charge-transfer kinetics may restrict their practical electrochemical performance. In this context, the incorporation of reduced graphene oxide (rGO) offers an effective strategy to improve electrical conductivity, facilitate electron transport, and enhance the electrochemically active surface area. The present study focuses on the synthesis and comparative investigation of $NiWO_4$-rGO and $CoWO_4$ nanocomposites for high-performance supercapacitor applications. The structural, morphological, and compositional characteristics of the synthesized materials are investigated using appropriate characterization techniques, including X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), Raman spectroscopy, scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDS). Their electrochemical properties are evaluated through cyclic voltammetry (CV), galvanostatic charge–discharge (GCD), and electrochemical impedance spectroscopy (EIS). Particular emphasis is placed on understanding the influence of rGO incorporation on specific capacitance, rate capability, charge-transfer resistance, energy density, power density, and cycling stability. Furthermore, the comparative electrochemical behaviour of $NiWO_4$-rGO and $CoWO_4$-based electrodes is examined to establish the relationship between their structural characteristics and charge-storage mechanisms. The investigation is expected to provide valuable insights into the design of transition-metal tungstate-based nanocomposites as efficient electrode materials for advanced electrochemical energy storage devices.

Keywords: $NiWO_4$-rGO; $CoWO_4$; Nanocomposites; Reduced Graphene Oxide; Supercapacitors; Electrochemical Energy Storage; Specific Capacitance; Electrochemical Impedance Spectroscopy.

ICEMSET-2026/FS/INV/604

Influence of Silver Nanoparticle Incorporation on the Photodetection Properties of Nb_2O_5 Nanowires

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Abstract

This work demonstrates enhanced ultraviolet (UV) photodetection performance using silver (Ag)-assisted vertically aligned niobium pentoxide (Nb_2O_5) nanowires (NWs) fabricated through the glancing angle deposition (GLAD) technique integrated into an electron-beam (e-beam) evaporation system. The incorporation of Ag into the Nb_2O_5 nanowire architecture is investigated as an effective approach to improving the optoelectronic performance of UV photodetectors. The successful formation and morphology of the Ag-assisted Nb_2O_5 NWs are confirmed through field-emission gun scanning electron microscopy (FEG-SEM). The fabricated photodetector exhibits high responsivity and a detectivity of 2.6×10^{14} Jones, accompanied by a remarkably low noise-equivalent power (NEP) of 4.96×10^{-16} W. Furthermore, the device demonstrates rapid photoresponse characteristics, with rise and fall times of 0.154 s and 0.161 s, respectively. These results indicate excellent photoresponse characteristics and highlight the potential of GLAD-fabricated Ag-assisted Nb_2O_5 nanowire architectures for high-performance UV photodetection applications.

Keywords: GLAD; Nanorod; High sensitivity, Ag.

ICEMSET-2026/FS/INV/605

Polyacrylonitrile–Hydrogen Titanate Nanotube Nanocomposite Beads: Material Engineering, Characterisation and Application in Water Purification

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Abstract

The integration of functional nanostructures into polymer matrices offers opportunities for developing advanced composites for environmental applications. In this study, porous polyacrylonitrile (PAN)–hydrogen titanate nanotube (HTNT) nanocomposite beads were fabricated through a facile phase-inversion process, enabling scalable production of stable and recoverable adsorbent architectures. Structural, chemical and morphological characterisation using XRD, FTIR, XPS, SEM, BET and TGA confirmed effective nanomaterial integration, accessible porosity and favourable thermal stability. Their environmental functionality was demonstrated through the removal of Cd(II), Pb(II) and Hg(II) from aqueous solutions. Metal-ion uptake involved synergistic surface complexation, ion exchange, electrostatic interactions and chemical adsorption facilitated by hydroxyl and metal-oxide functionalities. Remarkably, dosage as low as 1 g/L achieved substantial removal, reducing toxic metal concentrations to WHO-permissible limits. This work highlights the potential of polymer nanocomposite engineering for sustainable water purification, supporting SDGs 3, 6 and 12.

Keywords: Polymer nanocomposites; Polyacrylonitrile; Hydrogen titanate nanotubes; Phase inversion; Heavy metal adsorption; Water purification.

ICEMSET-2026/FS/INV/606

Shear Acoustic Wave Propagation in Imperfectly Bonded Piezoelectric–Functionally Graded Cylindrical Structures

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Abstract

This talk presents a theoretical investigation of shear acoustic wave propagation in a piezoelectric cylindrical layered structure consisting of a piezoelectric material cylinder imperfectly bonded to a concentric functionally graded piezoelectric material (FGPM) cylindrical layer of finite width. The material properties of FGPM layer are assumed to vary continuously along the radial direction, while mechanical and electrical imperfections at the interface are incorporated to represent possible interfacial damage. By applying suitable mathematical transformations, the governing coupled electromechanical field equations are reduced to Bessel's differential equations, leading to analytical dispersion relations for shear acoustic waves under electrically short and electrically open conditions. The validity of derived relations is established through comparisons with previously published results and the classical Love wave equation as a special case. Furthermore, effects of the functional grading parameter, radius ratio, wave number, order of the Bessel functions, and mechanical and electrical interface imperfection parameters on the phase velocity are examined through numerical simulations and graphical illustrations.

Keywords: Bessel's function; Cylindrical co-ordinate; Functionally gradient parameter; Imperfect interface; Piezoelectricity; Shear acoustic wave.

ICEMSET-2026/FS/INV/607

Polymer Nanocomposites at the Interface of Sustainability, Innovation and Advanced Engineering

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Abstract

Polymer nanocomposites have emerged as advanced multifunctional materials, offering significant opportunities for sustainable materials development and engineering innovation. Natural rubber, owing to its renewable origin, inherent elasticity and flexibility, provides a promising matrix for developing high-performance nanocomposites. The incorporation of hybrid nanofillers, particularly organically modified layered double hydroxides (OLDHs) in combination with multiwalled carbon nanotubes (MWCNTs), graphene or quantum dots, enables the systematic tailoring of electrical, dielectric and electromagnetic properties. Synergistic interactions between nanofillers, interfacial engineering and scalable processing techniques, such as two-roll mill mixing, contribute to improved filler dispersion and enhanced functional performance. These advances facilitate the development of materials exhibiting low electrical percolation thresholds, enhanced dielectric response, tunable electrical conductivity and effective electromagnetic interference (EMI) shielding. Such multifunctional nanocomposites offer promising prospects for flexible electronics, smart sensors, energy devices and advanced engineering applications. This work highlights the potential of sustainable polymer nanocomposites as innovative materials for next-generation technologies.

Keywords: Polymer nanocomposites; Natural rubber; Hybrid nanofillers; Organically modified layered double hydroxides; Sustainable materials; Dielectric properties; EMI shielding; Advanced engineering.

ICEMSET-2026/FS/INV/608

Synthesis and Optical Properties of ZnS/CdS-Based Core-Shell and Quantum Dot-Quantum Well Heterostructures

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Abstract

Three-dimensional heterostructures, including core-shell and quantum dot-quantum well (QDQW) architectures based on ZnS and CdS, have attracted considerable interest for optoelectronic applications owing to their tunable electronic and optical properties. In this study, ZnS/CdS-based heterostructures were synthesized using a wet-chemical deposition route. Their structural, optical, and luminescence properties were systematically investigated using X-ray diffraction (XRD), transmission electron microscopy (TEM), optical absorption, and photoluminescence (PL) spectroscopy. The absorption spectra exhibited a shift in the absorption edge with increasing growth duration, indicating changes in the electronic structure associated with heterostructure formation. Furthermore, PL studies revealed enhanced luminescence intensity in the heterostructures compared with the individual quantum dots. These findings demonstrate the potential of ZnS and CdS quantum dots as versatile building blocks for engineering core-shell and ZnS/CdS/ZnS quantum dot-quantum well architectures with tailored optical and luminescence properties, offering promising opportunities for nanoscale optoelectronic applications.

Keywords: Quantum dot-Quantum well; Heterostructure; Core-shell; Photoluminescence; Absorption spectroscopy.

ICEMSET-2026/FS/INV/609

Artificial Intelligence and Computational Technologies in Industrial Pharmaceutics

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Abstract

Industrial pharmaceutics is undergoing a fundamental transformation thanks to computational and artificial intelligence (AI)-driven techniques, which are replacing traditional trial-and-error experimentation with data-backed, multi-scale engineering. For complicated dosage forms like tablets, 3D-printed medications, long-acting injectables, and nanomedicines, machine learning (ML) and deep learning algorithms forecast mechanical characteristics, solubility, chemical stability, and drug release profiles. Target identification, de novo molecular design, lead optimization, and ADMET (absorption, distribution, metabolism, excretion, and toxicity) safety profiling are all accelerated by generative adversarial networks (GANs), deep docking, and transformer models. On the production floor, real-time defect detection, film-coating thickness measurement, and particle size analysis are automated by computer vision and convolutional neural networks (such YOLOv5 and ResNet). Platforms such as digital twins reduce material waste and save unnecessary physical trials by simulating end-to-end manufacturing workflows from lab to pilot to commercial scale. Real-time inventory management, demand forecasting, cold-chain IoT tracking, and automated regulatory submission documentation are all optimized by predictive analytics.

Keywords: Artificial Intelligence (AI), Machine Learning (ML), Deep Learning, Digital Twin Technology, Predictive Analytics.

ICEMSET-2026/FS/INV/610

Artificial Intelligence assisted Behavioural Modeling for Wide Bandgap Device to System interfacing

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Abstract

Modernization has led the path towards denser circuitry, faster signal processing and miniaturized consumer modules. Sometimes it is from the material perspective and in some other cases from the structural view point. Lately, researchers have concentrated on mixing up both material and structural benefits and performance estimation is done on these non-conventional devices. Now to get these devices operable on benchmarked systems, a device-to-system simulation is required to find the optimum point of module output before they are manufactured alongside that system of interest. This process eliminates possible errors and minimizes the cost burden. In general, the devices that are frequently used in circuits have their characteristics saved on all the well-established system simulation platforms. However, the problem arises when a lesser-known or newly discovered device proceeds for its placement there. Hence the necessity of developing a behavioral modeling technique to seamlessly utilize those devices felt essential. We've therefore proposed a TCAD to SABER process flow and expanded that with the wider possibilities of artificial intelligence. As a proof of concept, a conventional switch in a continuous conduction mode - closed loop control (CCM-CLC) Boost Converter has been replaced with that GaN switch. The need for artificial intelligence (AI), methodology of usage and significance of performance in device modelling and system interfacing is later discussed. To be more specific, the variability on TCAD to generate more data from the devices needs more and more computational ability. This requires the overall process to get prolonged than expected. Hence any nascent technology of modern times needs AI that reduces the data-generation time, predicts millions of data points precisely, and can be convenient for both device and system platforms.

Keywords: Behavioral modeling; SABER; Gallium Nitride; β-polymorphic Gallium Oxide; Diamond; CCM-CLC; P-&-O algorithm; AI; Random Forest; Machine Learning.

ICEMSET-2026/FS/INV/611

Wet chemical Synthesis of Ag/$SmFeO_3$ Perovskite Nanostructures for Ultrasensitive Electrochemical Detection of Butylated Hydroxyanisole

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Abstract

Perovskite-based nanostructured materials have gained considerable attention in electrochemical sensing applications owing to their tunable physicochemical properties, structural stability, and electrocatalytic activity. In this study, silver-doped samarium ferrite ($Ag/SmFeO_3$) perovskite nanostructures were synthesized via a hydrothermal method and investigated for the sensitive electrochemical determination of butylated hydroxyanisole (BHA). The synthesized nanostructures were systematically characterized to examine their structural and morphological properties. X-ray diffraction (XRD) analysis confirmed the formation of a highly crystalline orthorhombic $SmFeO_3$ perovskite phase with successful incorporation of silver and without significant impurity phases. The average crystallite size of approximately 18 nm, using the Debye–Scherrer equation. Scanning electron microscopy (SEM) revealed predominantly spherical nanoparticles with a relatively uniform distribution. The electrochemical performance of the synthesized materials was evaluated using modified glassy carbon electrodes (GCEs). The $Ag/SmFeO_3$-modified electrode (ASFO@GCE) exhibited anodic peak current at 0.57 V, indicating electrochemical activity towards BHA oxidation. Differential pulse voltammetry (DPV) demonstrated a wide linear detection range of 0.05–562.84 μM, with a calculated limit of detection (LOD) of 5.6 nM. These findings demonstrate the potential of hydrothermally synthesized $Ag/SmFeO_3$ perovskite nanostructures as a promising electrode material for sensitive electrochemical detection of BHA, with potential applications in food safety monitoring.

Keywords: $Ag/SmFeO_3$; Perovskite nanostructures; Hydrothermal synthesis; Butylated hydroxyanisole; Electrochemical sensing.

ICEMSET-2026/FS/INV/612

Semiconductor Industry in India: Techno-economic imperatives, strengths and challenges

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Abstract

Many technologies of all industries have electronic subsystems, which in turn have semiconductor devices. Hence semiconductor technology is essential for manufacturing in all sectors of industry. Hence, to reduce the import component in the manufacture of any subsystem, it is imperative to indigenize semiconductor technologies. More so, since India's market for electronics being huge. Developing indigenous semiconductor technologies is imperative to earn/save substantial foreign exchange. In addition, semiconductors being processed at nanometer sizes, these are of most sophisticated of all technologies. Huge technological manpower of India finds it interesting to take up such challenges. Considering such factors, this paper aims at focused discussion on India's imperatives, initiatives, challenges, and roadmap for taking up semiconductor manufacturing in a big way. The methodology has been to summarize key documents published by NITI Aayog and others. This would be an appraisal of essential policy aspect to the technically intense experts in the field.

Keywords: Semiconductors; Indigenous manufacture; Indian Semiconductor Industry; Policy of semiconductor manufacture; Development of semiconductor manufacture.

ICEMSET-2026/FS/INV/613

Functional Semiconductor Nanostructures for Water Pollution Monitoring and Management

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Abstract

The morphology tunable photophysical and photochemical properties of semiconductor nanostructures have driven extensive research interest. Present paper focuses on intrinsic and extrinsic functional semiconductor nanostructures synthesized via facile bottom-up synthesis routes, highlighting their applications for water

pollution monitoring and management.Crystallographic, topographic and morphological characterizations of synthesized materials have been done by powder X-ray diffraction, Field emission scanning electron microscope and transmission electron microscope/High resolution transmission electron microscope, respectively. Fourier transform infrared spectroscopy, UV-Vis. absorption spectroscopy and energy dispersive X-ray spectroscopy measurements have been done for qualitative, quantitative and optical analyses. Photo-catalytic activity of synthesized nanomaterials under UV irradiation has been tested using Methylene Blue dye as a test contaminant in aqueous media. ppb-level detection of heavy metal ions in drinking water and norfloxacin sensing ability of the synthesized nanostructures have been analyzed by fluorescence spectroscopy. Functional semiconductor nanostructures are promising candidates for water pollution monitoring and remediation.

Keywords: Functional Semiconductor nanostructures; Photo-catalytic Activity; Sensing; Crystallography; Morphology.

ICEMSET-2026/FS/INV/614

Design and Tissue Detuning Analysis of an Ultra-Compact Slot-Loaded Microstrip Antenna for In-Body Biomedical Applications

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Abstract

This paper presents the design and detuning analysis of an ultra-compact microstrip antenna for in-body biomedical wireless applications at 2.4 GHz. The proposed antenna is designed on an FR4 substrate with a relative permittivity of 4.4 and a thickness of 1.6 mm. With an overall footprint of 6 mm × 6 mm, initially analyzed under free- space conditions and subsequently investigated in the presence of homogeneous skin and multilayer skin-fat-muscle tissue models. Under free space conditions, a resonance is obtained at 2.4 GHz with an S_{11} of −30.26 dB. Biological tissue causes a downward frequency shift to 1.92 GHz for the homogeneous skin model and approximately 1.70 GHz for the multilayer tissue model. After geometrical optimization, the antenna tuned back to 2.4 GHz, where an S11 of -15.55 dB and a VSWR of 1.40 are achieved. A second resonance is obtained near 3.98 GHz with an S11 of −24.92 dB. At 2.4 GHz, the antenna achieves a simulated total gain of 7.7 dBi and a radiation efficiency of 10.09%. The specific absorption rate (SAR) analysis was fund to be within standard limits. The results demonstrate the antenna's potential for in-body biomedical wireless communication applications.

Keywords: Ultra-compact antenna, slot-loaded microstrip antenna, tissue detuning, biomedical antenna, tissue loading, tissue detuning, SAR analysis.

ICEMSET-2026/FS/INV/615

Experimental investigation of the effects of fibre orientation, stacking sequence and nanofiller incorporation on the thermo-mechanical properties of FRP composite

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Abstract

Fibre-reinforced polymer (FRP) composites are increasingly used in structural applications owing to their lightweight nature and excellent characteristics. Fibre orientation, stacking sequence and nanofiller incorporation are important factors influencing composite performance. In hybrid composites, incorporating carbon fibre between glass fibre can improve load distribution and mechanical performance. Changes in fibre orientation (0°–90°/45°–135°) resulted in increases of 18.49% in interlaminar shear strength (ILSS) and 7.7% in flexural strength. 0.2 wt% multi-walled carbon nanotubes (MWCNTs) incorporation in polymer improved ILSS

and flexural strength by 24.79% and 16.99%, respectively. Modified fibre orientation and stacking sequence of MWCNT hybrid composite enhanced ILSS and flexural strength by 50.17% and 60.9%, respectively. 17.8% increase in glass transition temperature (T_g) observed in nanohybrid composite with the optimized fibre orientation and stacking sequence. The optimized fibre orientation, stacking sequence and MWCNT incorporation can improve the performance of hybrid FRP composites.

Keywords: Fibre reinforced polymer composite, multiwalled carbon nanotube (MWCNT), ILSS, T_g

ICEMSET-2026/FS/INV/616

Next-Generation Aptamer-Based Nanomedicine: Computational Frontiers and Precision Therapeutic Strategies

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Abstract

In the rapidly evolving landscape of nanomedicine, aptamers have emerged as powerful molecular tools, demonstrating immense potential in targeted therapeutics, diagnostics, and drug delivery systems. This paper explores the computational features of aptamers in nanomedicine, highlighting their advantages over antibodies, including selectivity, low immunogenicity, and a simple production process. A comprehensive overview of the aptamer development process, specifically the Systematic Evolution of Ligands by Exponential Enrichment (SELEX), sheds light on the intricate methodologies behind aptamer selection. The historical evolution of aptamers and their diverse applications in nanomedicine are discussed, emphasizing their pivotal role in targeted drug delivery, precision medicine and therapeutics. Further, we explore the integration of artificial intelligence (AI), machine learning (ML), Internet of Things (IoT), Internet of Medical Things (IoMT), and nanotechnology in aptameric development, illustrating how these cutting-edge technologies are revolutionizing the selection and optimization of aptamers for tailored biomedical applications. This paper also discusses challenges in computational methods for advancing aptamers, including reliable prediction models, extensive data analysis, and multi-omics data incorporation. It also addresses ethical concerns and restrictions related to AI and IoT use in aptamer research. The paper examines progress in computer simulations for nanomedicine. By elucidating the importance of aptamers, understanding their superiority over antibodies, and exploring the historical context and challenges, this review serves as a valuable resource for researchers and practitioners aiming to harness the full potential of aptamers in the rapidly evolving field of nanomedicine.

Keywords: Aptamers, Nanomedicine, SELEX, Artificial Intelligence, Machine Learning, Computational Modeling, Precision Therapeutics.

ICEMSET-2026/FS/INV/617

Recent Trends in all Solid State 2D/3D Microbatteries: Challenges, Novel Materials, Design and Technologies

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Abstract

The swift advancement of miniaturized portable, and wearable electronic gadgets has propelled investigations into microscale energy-storage solutions for streamlined and autonomous systems viz. SQUIDS, MEMS & NMES, integrated passive components, implantable medical devices, sensors etc. As such, there has been tremendous pressure on battery engineers and researchers on the development of ultra high energy and power density power sources of matching configuration to meet the requirements. In this context, all-solid-state thin film microbatteries (SSMBs) with an extended cycle life, broad temperature operation range, and minimal self-discharge rate have attracted considerable attention. The stacking dense thin films reduces the Li-ion diffusion length, thereby improving the rate capability. It is vital to fabricate 2D/3D microbatteries with higher energy density, rate capability and stability on the same scale and using the same type of thin film processing

techniques used in microelectronics such as RF/DC magnetron sputtering, pulsed laser deposition, molecular beam epitaxy, PECVD etc. with foot prints of the order of (50 -100 μm)^2 having capabilities to provide currents of the order of 100-200 μA/cm^2 with a storage capacity in the range 100-200 μAh/cm^2. These microbatteries with thickness less than 10 μm are now being developed to provide integrated power for implantable microdevices like smart cards, tags, wireless electronic shelf edge labels, wearable devices, sensors and cellular phones, where flatness is a prime necessity. However, multiple challenges, such as interfacial instability, low volumetric energy density and high manufacturing cost, still hinder the widespread application of microbatteries. At present, many approaches, such as materials optimization and novel architecture design, have been explored to enhance the stability and energy density of solid state microbatteries. An overview of these discoveries and developments will be presented, together with new insights into the intrinsic mechanisms of operation which facilitates further improvements and to provide integrate onchip power in future microelectronic gadgets.

Keywords: Solid-state micro-batteries; Thin film technology; Architecture design: Two(2D) /three-dimensional (3D)

ICEMSET-2026/FS/INV/618

Carbon Dots - A Prospective Substrate for Assaying Biomolecules, Environmental Pollutants and Develop Latent Fingerprint

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Abstract

In recent years, Carbon Dots (CDs) have attracted dramatic attention and extensive research interest due to their significant physical and chemical properties, in addition to their tunable photoluminescence, large optical absorptivity, favorable bio-compatibility, good chemical stability, and low toxicity. CDs being regarded as a prospective substrate potential for exciting applications in construction of photovoltaic devices, sensors, as bioimaging tool, in a catalysis, medical diagnosis, and pollutants detection. The excellent hydrophilicity and presence of oxygen-containing surface multifunctional groups, CDs are considered as a prospective substrate for assaying biomolecules and environmental pollutants. The surface functional groups such as hydroxyl (-OH), carboxyl (-COOH), carbonyl (C=O), amino (-NH_2), and other nitrogen containing functional groups (C - N, C = N) enhances the chemical reactivity and water solubility of CDs. The spectacular electronic properties of CDs is that it can act as electron-donor or electron-acceptor, depending on its chemical structure which is based on 2 types of approaches in synthesis, namely the “bottom-up” and the “top-down”. In the Bottom-Up approach, CDs are built up from organic molecules or polymer precursors by hydrothermal/solvothermal, microwave, or pyrolysis methods. On the other hand, in the Top-Down approach, CDs are obtained by cleaving or cutting the large carbon cluster structure into small carbon nanoparticles until the desired particle size is reached. Their unique physicochemical and optical properties such as strong luminescence, good biocompatibility, tunable optical characteristics, and low toxicity make them suitable for multifunctional platforms for applications In sensing applications, the strong fluorescence and abundant surface functional groups of CDs enable sensitive and selective detection of a wide range of analytes, particularly metal ions, biomolecules, and antibiotics. Different fluorescence responses arising from analyte–surface interactions provide opportunities for developing simple and rapid sensors for environmental and biological analysis. Beyond sensing, CDs exhibit promising photocatalytic properties by facilitating photoinduced charge generation and transfer, enabling the degradation of organic pollutants such as dyes under light irradiation. Their intense and tunable fluorescence can also provide high-contrast visualization of latent fingerprints, demonstrating their potential for forensic imaging and identification. Furthermore, their favorable optical characteristics and biocompatibility make CDs promising fluorescent probes for cellular imaging and other biological applications. These advances provide promising pathways toward practical carbon-dot-based technologies for environmental monitoring, analytical sensing and forensic investigation.

Keywords: Carbon Dots, Sensor, Photocatalysis, Environmental remediation Fingerprint imaging.

ICEMSET-2026/FS/INV/619

Primary Cilia as a Next-Generation Biologically Aligned Platform for Targeted Drug Delivery in Cancer Therapy

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Abstract

Emerging drug-delivery strategies increasingly seek biologically aligned carriers that combine biocompatibility with efficient therapeutic transport. Here, we highlight primary cilia, naturally produced cellular sensory organelles, as a novel platform for drug delivery. Primary cilia isolated from renal epithelial cells were engineered with a targeted chemotherapeutic payload to develop a cilia-based delivery system. In a mouse melanoma model, this platform significantly inhibited tumor progression and reduced drug-induced cardiotoxicity compared with the free drug. Multimodal imaging using confocal microscopy, IVIS-CT and ultrasound further supported targeted delivery, reduced off-target effects and improved local blood flow within the tumor. The intrinsic biological origin and ciliary membrane architecture may provide advantages in biocompatibility and cargo protection. These findings establish primary cilia as a promising, physiologically derived carrier concept for the delivery of drugs, nucleic acids, proteins and other biomolecules, opening new opportunities for biologically aligned strategies in cancer treatment.

Keywords: Primary cilia; Novel delivery vehicle; Targeted drug delivery; Cancer therapy; Nanotechnology.

ICEMSET-2026/FS/INV/620

Intermolecular relaxation of dipolar plastic crystalline material in non-polar glass forming matrix

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Abstract

It is well established that rigid dipolar materials dispersed in small concentrations within a nonpolar glassy matrix exhibit a secondary (β) relaxation associated with the solute molecules, commonly referred to as Johari–Goldstein (JG) relaxation, which is intermolecular in nature. In this study, we investigate this sub-Tg relaxation process of cyclohexyl chloride, a dipolar solute dispersed into non-polar glassy systems using dielectric spectroscopy over a frequency range of 20 Hz to 1 MHz and at temperatures down to 80 K. The Non-polar matrices employed in this investigation are isopropylbenzene (IPB), ortho-terphenyl (OTP) and di-methylcyclohexane (DMCH). The dipolar solute exhibit two relaxation processs one above and one below Tg in all non-polar matrix. The sub-Tg relaxation observed in studied non-polar matrix may be attributed to a Johari–Goldstein ot intermolecular relaxation.

Keywords: Plastic crystalline material, Dielectric spectroscopy, Glass transition temperature, Secondary or JG-relaxation, Primary relaxation.

ICEMSET-2026/FS/INV/621

Crystal Structure, Dielectric Properties and Electrical Relaxation in Niobate-Based Tetragonal Tungsten Bronze Ceramics: Effects of W^{6+}/Mo^{6+} Substitution

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Abstract

Niobate-based tetragonal tungsten bronze (TTB) ceramics offer versatile crystal frameworks for tailoring dielectric and electrical properties. This invited talk presents results from our investigations of $Ba_{0.54}Na_{0.46}Nb_{1.29}W_{(0.37-x)}MoxO_5$ ($0 \leq x \leq 0.33$) and related molybdate ceramics synthesized by solid-state reactions. X-ray diffraction, Rietveld refinement and Raman spectroscopy identify tetragonal P4bm TTB phases, while Mo incorporation is accompanied by secondary $BaMoO_4$ formation. Temperature- and frequency-dependent dielectric measurements reveal composition-sensitive transitions: the reported transition temperature increases from 250.84 °C at x = 0 to 288.36 °C at x = 0.08, whereas peak permittivity at 1 kHz decreases with increasing Mo content. Related molybdate samples exhibit coexisting tetragonal and orthorhombic phases. Impedance spectroscopy of $Ba_{0.54}Na_{0.46}Nb_{1.29}W_{0.37}O_5$ further reveals non-Debye relaxation involving grain, grain-boundary and electrode contributions. Together, these findings emphasize the importance of phase assemblage and microstructure in interpreting the electrical response of TTB-based functional ceramics.

Keywords: Tetragonal tungsten bronze; niobates; molybdenum substitution; Rietveld refinement; dielectric properties; impedance spectroscopy.

ICEMSET-2026/FS/INV/622

Can We Trust the AI Scientist? Reliability, Hallucination, and Verification in LLM-Driven Autonomous Laboratories

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Abstract

Large language model (LLM) agents are increasingly embedded in autonomous laboratories, where they mine literature, plan experiments, and steer robotic platforms in closed loops. Yet reports of fabricated references, erroneous extractions, infeasible plans, and over-claimed discoveries raise a central question: can the AI scientist be trusted? This paper first develops a taxonomy of failure modes across the agentic pipeline, spanning literature mining, experiment planning, robotic execution, and data analysis, and maps each failure to the plan, act, observe, and reflect loop. It then critically compares existing mitigation strategies, including retrieval grounding, tool-based verification, critic and multi-agent checking, uncertainty estimation, and expert review, assessing what each detects, what it misses, and its cost. The resulting comparison matrix links safeguards to failure types and exposes unresolved gaps. The work offers researchers and lab managers a practical, structured basis for designing more reliable, verifiable, and reproducible autonomous discovery systems.

Keywords: Agentic AI, large language models, self-driving laboratories, hallucination, verification, reliability, materials discovery.

ICEMSET-2026/FS/INV/623

Bio-Integrated Sensing Technologies: Harnessing Microbial Systems for Sustainable Environmental and Biomedical Applications

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Abstract

Bio-Integrated Sensing Technologies: Harnessing Microbial Systems for Sustainable Environmental and Biomedical Applications Microbial systems offer immense potential for developing sustainable biotechnological solutions through their diverse metabolic capabilities and interactions with biological and environmental

substrates. My research explores the biotechnological potential of microorganisms associated with insect and reptilian gut ecosystems, particularly their applications in biodegradation, enzyme production, and sustainable waste valorization. Investigations on polystyrene-degrading bacteria and the bioprospecting of chitinolytic microorganisms highlight the potential of microbial resources in converting complex biological and synthetic waste into value-added products. Building upon these microbial platforms, this talk will explore the broader applications of microbial enzymes, biological recognition elements, and bio-integrated sensing approaches in environmental monitoring and biomedical applications. The integration of microbial biotechnology with emerging sensing technologies and advanced materials offers promising opportunities for developing innovative, sustainable, and application-oriented solutions to contemporary environmental and healthcare challenges.

Keywords: Microbial Biotechnology; Insect Gut Microbiota; Chitinolytic Bacteria; Biodegradation; Sustainable Waste Valorization.

ICEMSET-2026/FS/INV/624

Flame retardancy in bio-based polyamide via magnesium hydroxide/ nano-clay hybrid system

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Abstract

Developing sustainable, halogen-free flame-retardant polymers is essential for advanced engineering applications. In this study, bio-based polyamide 4.10 (PA 4.10) nanocomposites incorporating magnesium hydroxide (MH) and nano-clay (NC) have been prepared by melt blending to investigate their thermal and fire-performance characteristics. TGA shows changes in thermal degradation behaviour and increased char residue with filler incorporation. UL-94 testing shows that adding 10 wt% MH improves self-extinguishing behaviour, thereby achieving a V-2 rating. Cone calorimetry analysis shows substantial reductions in peak heat release rate (PHRR), total heat release (THR), and maximum average rate of heat emission (MARHE), reduced by 69%, 33%, and 43.54%, respectively, as compared with neat PA. These findings highlight the potential of MH/NC incorporation to modify the thermal degradation and combustion behaviour of bio-based PA 4.10 composites for sustainable engineering applications.

Keywords: Thermal stability, Flame retardant nanocomposites, Magnesium hydroxide, Nano-clay, Sustainable bio-based polyamide.

ICEMSET-2026/FS/INV/625

A Review of the Performance of Advanced Fiber-Reinforced Materials for 3D Concrete Printing (3DCP)

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Abstract

3D concrete printing (3DCP) is a promising technology that has garnered the construction industry's attention for several advantages over conventional construction, including reduced material waste, lower costs, reduced

labour, faster execution, and greater design flexibility. However, 3D-printed concrete (3DPC) is brittle and in case of 3DCP the cement consumption is increased by 40 % compared to conventional construction. In traditional construction, steel reinforcement is provided to improve the flexural strength to the concrete. However, due to several disadvantages associated with steel reinforcement, researchers are exploring engineered cementitious composites and fiber reinforced concrete. Several studies have been deploying different fiber materials such as polypropylene, basalt and glass to improve the flexural and tensile properties of the cement paste in case of 3DCP. The presentation reviews several researches works that studied the feasibility of deploying advanced fiber materials for improved performance of concrete paving the way for wide application of 3DCP technology.

Keywords: 3DCP, 3DPC, Concrete, Fibre.

ICEMSET-2026/FS/INV/626

Waste to Wealth: Development of Carbon-Based Counter Electrodes Fro Plastic Wastes for Integrated Dye-Sensitized Solar Cells

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Abstracts

Need for sustainable recycling and waste management strategies. This works focuses on the conversion of waste plastics into carbon-based materials and their potential application as electrode materials in integrated super capacitor and dye-sensitized solar cells (DSSCs). Waste plastics are utilized as carbon precursors and converted into carbon materials through carbonization. The obtained carbon materials can be further processed and characterized to investigate their structural, morphological, and electrochemical properties. The synthesized carbon is counter electrode in DSSCs, due to its potential electrical conductivity, chemical stability, catalytic activity, and low-cost availability. The prepared carbon electrode is expected to facilitate the reduction of the redox electrolyte and improve charge-transfer processes within the solar cell. The structural and surface properties of the carbon material can be evaluated using X-ray diffraction (XRD), scanning electron microscopy (SEM), and electrochemical techniques. Furthermore, the photovoltaic performance of the fabricated DSSC can be investigated through current density–voltage (J–V) measurements. This approach aims to establish a value-added application for plastic waste while developing cost-effective and sustainable electrode materials for renewable energy conversion.

Keywords: waste plastics, carbon, dye sensitized solar cell, super capacitor, and integrated device.

ICEMSET-2026/FS/INV/627

GC-MS Profiling, Preparation, Physicochemical Characterization and Preliminary Antimicrobial Evaluation of *Cyperus scariosus* R.Br. plant extract and Essential Oil Nanoemulsion

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Abstract

Cyperus scariosus R.Br. essential oil (CSEO) is a medicinal plant-derived bioactive with limited aqueous dispersibility and physicochemical instability. In the present study, CSEO was characterized using GC-MS and formulated into a nanoemulsion through probe ultrasonication. GC-MS identified 16 volatile compounds, predominantly sesquiterpene hydrocarbons (44%) and oxygenated sesquiterpenes (46%), with two major constituents accounting for 54.22% of the total oil composition. The prepared nanoemulsion showed a mean droplet size of 576.58 ± 41.65 nm, polydispersity index of 0.977, and zeta potential of −16.92 ± 0.33 mV. FTIR analysis confirmed successful encapsulation without chemical degradation. The nanoemulsion exhibited concentration-dependent antioxidant activity, with maximum DPPH and H_2O_2 scavenging of 79.1% and 72.3%,

respectively, at 400 µg/mL. Antibacterial and antifungal assays demonstrated activity against *E. coli*, *S. aureus*, *Rhizopus stolonifer* and *Aspergillus niger*. The findings demonstrate the potential of ultrasonication-based nanoemulsification for improving the delivery and biological applications of *C. scariosus* essential oil, while further optimization of formulation parameters is required. Such optimization could support the development of CSEO-based nano-formulations for potential pharmaceutical, nutraceutical and other biomedical applications. Plant extract was studied to evaluate aantioxidant properties using DPPH and H2O2 assays and Antimicrobial activities were evaluated using selected microbial strains.

Keywords: *Cyperus scariosus*, Essential oil, Nanoemulsion, GC-MS, Ultrasonication, Antimicrobial activity, Antioxidant activity, Caryophyllene oxide.

ICEMSET-2026/FS/INV/628

Nano-Fertilizer Enriched Sisal Mulch for Sustainable Crop Cultivation

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Abstract

Water scarcity and soil nutrient depletion are serious constraints in semi-arid vegetable cultivation. This study investigates the application of nano-fertilizer-enriched biodegradable nonwoven sisal mulch to enhance crop productivity, nutrient use efficiency, and soil health in cabbage (*Brassica oleracea* var. *capitata*) under water-limited, ridge-furrow flood irrigation. Sisal fibres derived from *Agave sisalana* were used as a biodegradable, reusable mulching substrate, and biogenically synthesized nano-colloidal formulations of zinc, iron, calcium, and magnesium were applied at graded doses in a field experiment; crop yield, nutritional quality, and post-harvest soil parameters were evaluated. Crop yield increased substantially, from 160 g per plant in the untreated control (M1) to over 1000 g per plant in the highest nano-fertilizer treatment (M1F4), a 534.45% improvement. Nano-treated plots showed higher moisture and sugar content, with moderate dose-dependent trade-offs in carbohydrate and protein levels. Post-harvest soil analysis showed improved micronutrient uptake, slightly reduced pH, and no harmful rise in electrical conductivity, while the sisal mulch retained structural integrity with only a 55 GSM weight reduction, confirming its reuse potential. Combined use of nano-fertilizers and reusable biodegradable sisal mulch offers a resource-efficient and economically viable strategy for improving vegetable production under water-scarce conditions.

Keywords: Crop yield; Nano-fertilizer; Needle-punched nonwoven; Sisal; Soil health; Sustainable agriculture.

ICEMSET-2026/FS/INV/629

A Comparative Study of Microwave and Conventional Heating in Fuyu Persimmon (*Diospyros kaki*): Changes in pH and Total Soluble Solids (°Brix)

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Abstract

Microwave and conventional heating differ in how thermal energy is delivered to food matrices, which may influence measured physicochemical properties. This study will evaluate the effects of these heating methods on pH and total soluble solids (°Brix) in ripe Fuyu persimmon (Diospyros kaki). Washed, prepared, and homogenized fruit will be divided into independent portions assigned to an unheated control, microwave heating and conventional water-bath heating. Heating conditions will be established in preliminary trials to bring the

two treated groups to the same target sample temperature. Sample mass, initial temperature, and temperature at measurement will be standardized. pH and °Brix will be measured before and after treatment using calibrated instruments. Results will be summarized as means and standard deviations, and treatment groups will be compared using appropriate statistical analysis. The study will determine whether microwave and water-bath heating produce different changes in pH and °Brix under the conditions tested.

Keywords: Fuyu persimmon; microwave heating; water-bath heating; pH; total soluble solids.

ICEMSET-2026/FS/INV/630

Studies on YFeO3 Based Complex Oxide Systems

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Abstract

This research presents a systematic investigation into Studies on $YFeO_3$ Based Complex Oxide Systems, focusing on the synthesis and characterization of YFO solid solutions modified with SBT and ZS oxides. These mixtures were prepared by heating them at 1150°C for 3 hours, which successfully retained their single-phase orthorhombic crystal structure. Scanning electron microscopy revealed a refined microstructure, dropping the average grain size from 3.4 µm in pure YFO down to 3.0 µm and 2.6 µm. Testing showed that the material can now absorb visible light much better, with its energy gap tuned between 1.8 eV and 2.8 eV. The internal stress from mixing these materials modified the internal atomic exchange bonds, which increased the material's magnetic strength. The smaller grain sizes helped the material hold an electrical charge much better while reducing energy waste. These combined improvements make these materials useful for making advanced electronic sensors and memory storage devices.

Keywords: Yttrium Orthoferrite (YFO); Solid Solutions; Orthorhombic Structure; Spontaneous Magnetization; Dielectric Properties.

ICEMSET-2026/FS/INV/631

Conversion of solar energy to hydrogen by thermochemical water splitting cycles: Challenges and opportunities

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Abstract

Renewable hydrogen is emerging as a promising energy vector for sustainable energy transition, owing to its potential as a clean energy source, versatile energy carrier, and chemical energy storage. Solar energy represents an abundant and virtually inexhaustible energy resource and can be harnessed for hydrogen production by water splitting through three principal pathways, namely electrolysis using solar electricity, thermochemical cycles using concentrated solar heat and photocatalysis using solar radiation directly as well as combination of these. Among these, solar thermochemical water splitting (STCWS) involves concentrating sunlight using mirrors on a reactor, heating it to high temperatures, driving the multistep endothermic decomposition of H_2O forming H_2 and O_2 separately, thus eliminating the need of their high-temperature separations. This review analyzes the various two, three and four steps STCWS cycles reported in the last 10 years and presents the technoeconomic analysis of hydrogen production cost.

Keywords: Thermochemical water splitting cycles; Hydrogen; Energy carrier, Energy storage; Solar.

ICEMSET-2026/FS/INV/632

AI-Driven Intelligent Control and Power Electronics for Next-Generation Smart Electronic Systems

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Abstract

Recent advances in artificial intelligence, semiconductor devices, and control technologies are creating new opportunities for developing intelligent and energy-efficient electronic systems. This talk explores how AI-based control strategies can improve the performance, reliability, and adaptability of modern power electronic applications. Particular attention is given to intelligent converters, adaptive control techniques, fault detection, and predictive maintenance. The discussion also highlights the growing importance of wide-bandgap semiconductor devices, including silicon carbide and gallium nitride, in achieving higher efficiency and improved power conversion capabilities. Emerging applications in renewable energy systems, electric vehicles, smart grids, and industrial automation are examined to illustrate the practical significance of these developments. Furthermore, the talk addresses challenges associated with real-time implementation, computational requirements, and system reliability. Finally, promising research directions are outlined, emphasizing the integration of intelligent control and advanced electronics for sustainable and autonomous technological solutions.

Keywords: Artificial Intelligence, Intelligent Control, Power Electronics, Emerging Technologies, Wide-Bandgap Semiconductors, Smart Electronic Systems.

ICEMSET-2026/FS/INV/633

From CFRP Waste to High-Performance Composites: Surface-Modified Recycled Carbon Fibres for Epoxy Reinforcement and GFRP Toughening

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Abstract

The sustainable utilization of recycled carbon fibers offers significant opportunities for developing high-performance polymer composites. This study investigates surface functionalization of industrial waste-derived chopped carbon fibers (CCFs) through oxidation followed by silanization to improve interfacial compatibility with epoxy. Successful modification, confirmed by FTIR, TGA, and morphological analysis, resulted in densely distributed, siloxane-rich surface structures. Incorporating 0.5 wt.% silanized CCFs (S-CCFs) improved the storage modulus of epoxy composites by approximately 376%, along with enhanced tensile and fracture properties, without compromising thermal stability. Subsequently, the modified epoxy system was employed for interlayer toughening of hybrid GFRP laminates. Laminates containing 0.5 wt.% S-CCFs exhibited improvements of approximately 27% in tensile strength, 39% in tensile toughness, 38% in flexural strength, and 13% in short-beam shear strength. These findings demonstrate a sustainable strategy for converting CFRP waste into value-added reinforcing materials for advanced epoxy composites and damage-tolerant laminated structures.

Keywords: Recycled chopped carbon fibres; Silanization; Epoxy composites; Interlaminar toughening; Hybrid GFRP laminates.

ICEMSET-2026/FS/INV/634

Performance Enhancement of Aodv Routing in Mobile Ad-Hoc Networks Using Rss-Based Cross-Layer Design

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Abstract

The Mobile Ad hoc Networks (MANETs) operates without fixed infrastructure, rely on multi-hop wireless links that may change rapidly because of node mobility and fluctuating channel conditions. In the network the routes are detected by the Ad-hoc On-Demand Distance Vector (AODV) protocol on demand, but conventional route selection does not explicitly account for instantaneous wireless-link quality. This paper presents an RSS-assisted cross-layer approach to AODV in which Received Signal Strength (RSS) information measured at the physical layer is shared with the network layer for route selection and route rediscovery. The documented Cross-Layer Design AODV (CLD-AODV) implementation uses an RSS threshold of −88 dBm. The thesis also investigates complementary mechanisms: DSTC-motivated Math1-AODV, PSO-based Math2-AODV, RSS-region/ring-search Routing Overhead Reduction (ROR-AODV), and an encryption/energy-balancing extension (ENC-AODV). Evaluation reported in the thesis uses NS-2.35, an NS-3 comparison for CLD-AODV, and Castadiva emulation using ten OpenWrt-compatible Wi-Fi routers, a LAN switch, and a laptop. The reported measurements show improved packet-delivery ratio and throughput in several CLD-AODV and ROR-AODV scenarios, lower packet loss in the CLD-AODV comparison, and lower total energy consumption for ENC-AODV at the tested energy-balance-factor settings. All values are reproduced as reported; ambiguous units and inconsistent table labels are identified rather than silently corrected. The proposed work specifies that sharing the information of physical-layer RSS can improve AODV route robustness under the evaluated conditions. Furthermore, for reproducibility, advance recurrent verification is required for experiment and implementation-levels.

Keywords: AODV, Castadiva, Cross-Layer Design, Distributed Space-Time Coding, MANET, PSO, Received Signal Strength, RSS Threshold, Route Selection, Routing Overhead.

ICEMSET-2026/FS/INV/635

AI in Education, Industry, and Life: A Comparative Study

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Abstract

Artificial Intelligence now-a-days influences the decisions we take these days from how people are learning, how they are working and how they are making their everyday decisions. The research paper we made compares the effects it has across various major fields. We have combined literature and a survey as well. In the sector of education, advanced chatbots, virtual tutors, and smart classrooms can help improve the education's reach, feedback and how we engage with it. But the benefits depend on several factors like privacy safeguards, the teacher's involvement and the infrastructure. In the sector of industry, machine learning can help in improving prediction, maintenance and also for recruitment and resource purposes, but this can harm them if the organization fails to redesign their current workflows or assign suitable roles to the specific person or machine. At the individual level, AI has a wide scope of implementation, like it can support decision making, reduce your daily effort by automating mundane tasks which require thinking. The main issue that arises with this is that depending too much on it can make us lose control of the choices we make, we will lose the ability to think independently, which in return can make our life even more difficult instead of sorting it. Our survey reinforces this dual effect at the individual level. AI is widely used on a daily basis and is perceived as useful while respondents continue to demand human oversight. The comparison not only shows the outcomes are determined

by AI alone but also by humans. AI depends on us for their success on how we design, manage and supervise it. This paper proposes a CI (Collaborative-Intelligent) approach in which AI automates stable, data rich tasks while helping humans in judging the uncertain socially sensitive situations which are not ethical.

Keywords: Artificial Intelligence, Education, Industry, Workplace, Automation.

ICEMSET-2026/FS/INV/636

Non-Invasive HbA1C Measurement

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Abstract

It is very inconvenient to take a blood sample from a diabetic patient's fingertip to assess glucose. Blood-related infections are more likely to occur when invasive methods like one-touch glucometers and laboratory tests are used. HbA1c level refers to the proportion of glycated hemoglobin (HbA1c) to the total amount of hemoglobin in blood (Kwon & Kim, 2022). Our red blood cell contains a protein called hemoglobin which binds to the blood glucose and forms glycated hemoglobin. When there is higher blood sugar, more blood sugar and hemoglobin combine and the quantity of glycated hemoglobin (HbA1c) becomes higher than usual. In this current paper, we design a unique non-invasive blood glucose measurement as a potential solution to this significant problem.

ICEMSET-2026/FS/INV/637

Analytical Modeling of Steady State Creep behavior in a Rotating Anisotropic Composite Disc

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Abstract

The present study focuses on the development of an analytical framework for investigating the plastic stress and strain behavior of a rotating anisotropic disc with a linearly varying thickness. The disc is considered to be fabricated from a metal matrix composite consisting of silicon carbide particles (SiCp) reinforced within a 6061 aluminum alloy matrix. The creep deformation characteristics are examined using Sherby's constitutive equation, while Hill's yield criterion is employed to account for the anisotropic yielding behavior of the material. The steady-state creep response is evaluated by incorporating a threshold stress approach with three different values of the stress exponent, namely, n = 3, 5, and 8. The creep-related material parameters, representing variations in yield stress, are adopted from experimentally established data reported in the existing literature. The comparative investigation reveals that the creep behavior of a rotating anisotropic disc with linearly varying thickness is more accurately represented by a stress exponent of n = 8 in comparison with the lower exponent values of n = 3 and n = 5.

Keywords: Analytical Modeling, Metal Matrix Composites, Anisotropy, Stress Exponent, Linearly Varying Thickness.

ICEMSET-2026/FS/INV/638

Recent Advances of Nickel Sulphide in Energy Storage and Conversion Devices

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Abstract

Increase in energy demand in world and continuous depletion of natural energy resources like coal, petroleum, fossil fuel, etc. is the major concern of 21st century. To overcome this problem; search the alternative of the non-renewable energy resources like solar cell, tidal force, rechargeable batteries, etc. Metal transition sulphide is the more suitable materials as electrode in supercapacitor, batteries, counter electrode in solar cell, etc. Because transition metal sulphide has unique electrical and various type of morphology, multiple oxidation state, high electrical conductivity, etc. Out of transition metal sulphide nickel sulphide attract attention due to multiple phases, reversible redox reaction, etc. because sulphide influence the surface chemistry and electronic structure which enhance the conductivity. In this review, study the fundamental characteristics of nickel sulphide like optical, different types of morphology, electrochemical properties like cyclic stability, areal and specific capacity, etc. and their application in energy storage and conversion devices.

Keywords: Nickel Sulphide, Solar cell, supercapacitor.

ICEMSET-2026/FS/INV/639

Coherent Brillouin Scattering of Laser Radiation in Transversely Magnetized Diffusive Semiconductors

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Abstract

The present work theoretically investigates coherent Brillouin scattering of laser radiation in transversely magnetized diffusive semiconductors. The interaction of intense electromagnetic radiation with charge carriers and acoustic phonons is studied by considering the combined effects of an externally applied magnetic field and carrier diffusion. A theoretical model is developed to describe the coupled dynamics of electromagnetic waves, carrier density fluctuations, and acoustic phonons in the semiconductor medium. Particular attention is given to the influence of magnetic-field strength, carrier diffusion, carrier concentration, collision frequency, and acoustic-wave parameters on the Brillouin scattering process. The analysis demonstrates that transverse magnetization can significantly modify the carrier transport and consequently influence the frequency shift, gain, and efficiency of coherent Brillouin scattering. Carrier diffusion further alters the nonlinear coupling between the optical and acoustic modes. The study provides useful insights into magneto-optical and carrier–phonon interactions in semiconductor media, with potential applications in tunable optical devices, coherent light sources, and semiconductor-based photonic systems.

Keywords: Coherent Brillouin scattering; Laser radiation; Transverse magnetic field; Diffusive semiconductors; Carrier–phonon interaction.

Faculty / Scientist Oral/Poster Presentations

ICEMSET-2026/FS/105

Ag coated MFe_2O_4 (M=Co, Ni, Zn) ferrite Nanocomposites for targeted drug delivery

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Abstract

MDA-MB-231 and MCF-7 cell lines were used to test the anticancer efficacy of Ag-coated MFe_2O_4 (M=Co, Ni, Zn) nanocomposites (NCs). The crystallite sizes of 14.6, 9.3, and 10.3 nm were assessed for Ag@CoF, Ag@NiF, and Ag@ZnF NPs, respectively using X-ray diffraction (XRD) patterns. The average particle sizes of 12.1, 5.7, and 10.7 nm were obtained for Ag@CoF, Ag@NiF, and Ag@ZnF NPs, respectively based on the HRTEM analysis. X-ray electron spectroscopy (XPS) was used to evaluate the oxidation states of Co^{2+}, Zn^{2+}, Ni^{2+}, Fe^{3+}, Ag^{0}, and O^{2-} for Ag@CoF, Ag@NiF, and Ag@ZnF NPs, respectively. The M-H hysterics of Ag@CoF, Ag@NiF, and Ag@ZnF NPs have reported saturation magnetization of 55.54, 30.29, and 25.55 emu/g; remnant magnetization of 14.36, 0.146, and 0.398 emu/g; and coercivity of 899.61, 6.19, and 28.72 Oe, respectively. The MTT assay was used to analyze Ag@MF NCs against MDA-MD 231 and MCF-7 cell lines at different concentrations.

Keywords: Microstructural analysis, Surface and Magnetic properties, Anticancer activity against.

ICEMSET-2026/FS/160

Nanoparticles Based Lubricants: The Future of Lubrication Technology for Journal Bearings

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Abstract

The need for energy efficient and long-lasting mechanical systems has pushed the development of advanced lubrication strategies to reduce friction and wear under extreme operating conditions. The focus has shifted to addition of nanoparticles instead of traditional additives to different variety of lubricating oils. Nanoparticle assisted lubrication has been found to be a potential method, but the tribological properties of nanoparticles are highly dependent on their concentrations, dispersion stability and interactions with contacting surfaces. The aim of the study is to examine the possibility of using titanium dioxide (TiO_2) nanoparticles as lubricant additives for enhancing static thermal properties for journal bearing applications. Study has been performed on different journal speeds, lubricating oils, loads and different concentartions of TiO_2. There has been significant increase (approximately 15%) in hydrodynamic pressure with slight increase in maximum temperature (less than 4%) with nanoparticles-based lubricants, which outlines importance of nanoparticles-based lubricants.

Keywords: Nanoparticles, Lubricants, Titanium dioxide, Journal bearings.

ICEMSET-2026/FS/181

Comparative Performance Analysis of Metaheuristic Optimization Algorithms for Photovoltaic Power Enhancement Under Partial Shading

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Abstract

Partial shading is one of the most frequently occurring fault conditions in Photovoltaic (PV) system which is capable of leading to substantial reduction in power generation. Shading condition in PV also develops multiple local maxima in the power-voltage (P–V) characteristics, thereby reducing the effectiveness of conventional Maximum Power Point Tracking (MPPT) techniques. To address this critical issue, optimization-based MPPT techniques have proven to be a promising solution to give optimised power out and efficiency from a PV system. In the present work, a 370 Wp monocrystalline PV module is shaded only with 20%of a single cell area representing spot shading and generating power output 295.86 W with an efficiency of 15.1% in an outdoor testing experiment, showing substantial performance degradation. To mitigate the losses and improve performance a comparative evaluation of six metaheuristic optimization algorithms is investigated under partial shading conditions. Among the evaluated algorithms, Grey Wolf Optimizer (GWO) showed the finest performance, delivering a maximum power output of 323.85 W, corresponding to a 9.46% improvement, along with the highest efficiency 16.55%. These results confirm that metaheuristic optimization techniques successfully improve power losses caused by partial shading.

Keywords: Photovoltaic (PV) systems; Partial shading; Metaheuristic optimization; Renewable Energy.

ICEMSET-2026/FS/207

Propagation dynamics of *q*-Gaussian laser beam in Plasma: Effect of Self-Focusing

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Abstract

The propagation of *q*-Gaussian laser beam in plasma plays an important role in non-linear optics and laser plasma interaction. Unlike conventional Gaussian beams, *q*-Gaussian beams provide greater flexibility in describing different beam profiles and propagation characteristics. The spatial behavior of *q*-Gaussian laser beam is studied that involves key phenomena like self focusing, beam width variation, self phase modulation and self trapping. The evolution entirely depends on parameters such as *q*-value, intensity of laser, plasma density and type of non-linear response. The result shows by controlling the various parameters, propagation of laser and its confinement can be controlled which is useful for applications in particle acceleration, plasma channel guiding and inertial confinement fusion.

Keywords: Self-focusing, self-trapping, self-trapping, inertial confinement fusion.

ICEMSET-2026/FS/216

Phonon Confinement study of Cadmium Sulphide thin film

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Abstract

Cadmium sulphide (CdS) thin films were prepared with the help of spin coating system at spin speeds of 500 rpm and 750 rpm. These as deposited CdS thin films were then annealed at different temperatures. The effect of annealing on CdS thin film was studied by using Raman spectroscopy and Phonon confinement model. The Raman spectroscopy studies and Raman curve fitting using Phonon confinement model fitting showed symmetric curve with an infinite phonon coherence length for as deposited CdS thin film. The phonon coherence lengths of 15 nm and 13 nm were obtained for the Cds thin film prepared at 500 rpm spin speed and annealed at 350 ^{o}C and 500 ^{o}C. The phonon coherence length was found to be 12 nm for the CdS thin film prepared at 750 rpm spin speed and annealed at 350 ^{o}C.

Keywords: Cadmium Sulphide (CdS), spin coating, Raman spectroscopy, Phonon confinement.

ICEMSET-2026/FS/218

Digital Twin: A Novel Approach in Drug Safety

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Abstract

Applications of recent development in science and technology are seen in every field including healthcare. Newer concepts like Digital twin have multiple use in health management. Drugs used for treatment of various diseases are known to produce adverse drug reactions (ADR), which usually are not manifested in all individuals who consume it. Digital twin replicates the real-world scenario in virtual space and thus can be used to predict the risks like ADR involved with usage of drugs. Here, High-performance Computational framework can be utilised for risk prediction of drugs like antibiotics, anti-malarial etc. in In-Silico trials. This has an advantage of being patient specific considering individual patient variability, continuous monitoring of patient, risk free approach and highly economical. Thus, digital twin has many applications in establishing drug safety.

Keywords: Digital twin, ADR, Drug safety.

ICEMSET-2026/FS/224

From Smart Homes to Smart Interiors: The Role of Emerging Technologies and Future Electronics in Spatial Design

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Abstract

The rapid evolution of technology is changing not only the way we communicate and work, but also the way we live and experience interior spaces. Emerging technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), smart and responsive materials, embedded electronics, immersive technologies, and intelligent building systems are creating opportunities to move beyond conventional interiors towards spaces that can sense, respond, adapt, and learn from their users. In this changing scenario, interior elements such as walls, ceilings, partitions, furniture, lighting, flooring, and finishes are no longer limited to providing shelter, function, and visual appeal; they can increasingly become active components of the interior environment. This paper presents a literature review of emerging technologies and future electronics in relation to interior design and interior structures, with emphasis on how technology can enhance human comfort, functionality, spatial experience, accessibility, sustainability, and personalisation. The study examines developments in smart environments, responsive materials, intelligent furniture, adaptive lighting, digital fabrication, sensor-based systems, and immersive technologies, while exploring their potential to create interiors that respond to changing environmental conditions and individual user needs At the same time, technological advancement introduces important questions concerning cost, maintenance, privacy, electronic waste, energy consumption, technological dependence, and the loss of human connection within highly automated environments. The review therefore emphasises the need for a balanced approach in which technology supports rather than dominates the design process. The study identifies a gap in existing research, particularly in the interdisciplinary integration of interior design principles, emerging technologies, material innovation, and interior structural systems. It proposes a human-centred approach to future interiors in which technology is thoughtfully embedded within the physical environment to create spaces that are intelligent yet intuitive, technologically advanced yet sustainable, and innovative while remaining comfortable, meaningful, and responsive to human needs. The study aims to contribute to the evolving field of smart interior design by providing a foundation for understanding how emerging technologies can shape the interiors of the future.

Keywords: Emerging Technologies; Future Electronics; Smart Interiors; Internet of Things; Artificial Intelligence; Smart Materials; Responsive Spaces; Intelligent Furniture; Sustainable Interiors; Human-Centred Design.

ICEMSET-2026/FS/225

SBF-Induced Mechanical Degradation of Modified ZE41A Mg Alloy

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Abstract

Magnesium (Mg) alloys are promising materials for biodegradable biomedical implants because of their low density, high specific strength, biodegradability, and biocompatibility. However, their rapid degradation in physiological environments may reduce mechanical integrity and limit clinical applications. The present study investigates the effect of simulated body fluid (SBF) immersion on the mechanical performance of ZE41A magnesium alloy subjected to powder-mixed wire electrical discharge machining (PMWEDM) and hydroxyapatite (HA) coating. Zinc powder was added to the dielectric medium during PMWEDM, followed by electrochemical deposition of HA coating. Surface morphology was examined using FE-SEM, while flexural and compression tests evaluated mechanical performance before and after SBF immersion. SBF immersion reduced both flexural and compressive strengths due to corrosion-induced surface deterioration and loss of structural integrity. PMWEDMed specimens exhibited the maximum strength reduction, highlighting the influence of surface modification on degradation behavior and mechanical stability.

Keywords: Magnesium alloy; Biodegradable implant; PMWEDM; Hydroxyapatite coating; Simulated body fluid; Mechanical properties.

ICEMSET-2026/FS/227

Emerging Technologies and Future Electronics in Interior Design: Towards Intelligent, Responsive and Human-Centred Spaces

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Abstract

Technology is becoming increasingly impactful in the spaces in which we live, work and communicate. Interior design is moving into a new stage where digital and electronic technology becomes an integral part of interior design. With increased use of artificial intelligence (AI), generative AI, smart lighting, sensors, , smart materials, and automation life is becoming comfortable. The paper explores the new possibilities for exploring design options, personalization, and decision making. Nevertheless, these innovations pose certain challenges connected with such aspects as privacy, cybersecurity and cost-effectiveness. Here in this study we have focused a human-cantered model that involves integration of technologies depending on the requirements of users, the character of the space and its environment. Thus, the study suggests that the future interior designer has to be able to act in the intersection between design, technology, sustainability and user experience. In conclusion, the study states that the success of intelligent interiors cannot be assessed according to their technological contents but rather due to the efficiency of technology application in them.

Keywords: Interior Design, New Technologies, Future Electronics, Internet of Things, Artificial Intelligence, Smart Interior Design, Smart Lighting, Extended Reality, Human Centred Design.

ICEMSET-2026/FS/234

The Technology in Smart homes for everyday lifestyle

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Abstract

The idea of having a smart home has changed from being a futuristic concept to a lifestyle Today, many homes can have devices that can listen, respond, monitor, learn, and make daily job easier. From commanding a

Google Nest Hub to play music or remind us about an appointment, to using smart plugs to switch appliances on and off remotely, technology is becoming has been a familiar part of the domestic environment. Home security cameras, video doorbells such as Ring, pet cameras, smart thermostats, and connected speakers are changing the way people interact with and experience their homes. This paper explores how the Internet of Things (IoT) is shaping the evolution of the modern smart home and, importantly, how these technologies are changing the way we think about residential interiors. Smart home devices are no longer simply gadgets placed within a room; they are gradually becoming part of everyday routines and the way people use, control and personalize their living spaces. A security camera can provide reassurance when a family is away from home, a pet camera can help owners stay connected with their animals, while a smart thermostat can adjust the indoor environment according to comfort and daily habits. The paper also looks at the perspective of interior design, where the introduction of connected devices creates new considerations for spatial planning, electrical points, furniture placement, privacy and aesthetics. The challenge is to incorporate technology without allowing it to dominate the visual character or emotional quality of a home. At the same time, questions surrounding data privacy, cyber security, dependence on technology and electronic waste cannot be overlooked. The study argues that the future of smart homes is not simply about having more connected devices. It is about creating homes where technology works quietly in the background and supports everyday life. A truly successful smart home should therefore be comfortable, intuitive, secure, sustainable and human-centred, with technology complementing rather than replacing the warmth and individuality of the home.

Keywords: Internet of Things (IoT), Smart Homes, Google Nest Hub, Smart Plugs, Security Cameras, Video Doorbells, Pet Cameras, Smart Thermostats, Connected Speakers, Interior Design, Home Automation, Human-Centred Design.

ICEMSET-2026/FS/287

Effect on Piezoelectric and Dielectric Properties of Ceramic-Polymer 0-3 Composites on Inclusion of ZnO-Nanoparticles as Third Phase

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Abstract

Lead zirconate titanate (PZT) ceramics exhibit high piezoelectric sensitivity, but their brittleness limits their use in sensors, transducers and actuators. Incorporating PZT into a polymer matrix overcomes this limitation by combining the functional properties of ceramics with the flexibility, toughness, lightweight nature and processing advantages of polymers. In particular, 0–3 ceramic-polymer composites offer good mechanical compliance and high dielectric breakdown strength. Their dielectric and piezoelectric properties can be further enhanced through incorporation of a suitable third phase. In the present work, dielectric and piezoelectric properties of ZnO-doped PZT–PEG nanocomposites (PZT volume fraction = 0.5) with varying ZnO concentrations were investigated. The composites were fabricated by hot pressing, producing approximately 200 μm thick sheets with 0–3 connectivity, followed by DC poling. The dielectric constant was measured over 100 Hz–1 MHz at room temperature. It decreased with increasing frequency, attributed to interfacial polarization and pores. Yamada's model showed good agreement with experimental dielectric behavior. ZnO doping significantly enhanced the dielectric response, particularly at higher concentrations, where particle percolation pathways are formed. The dielectric constant increased nearly three times compared with the undoped composite. The piezoelectric charge coefficient (d33) was analyzed using Furukawa's relation, showing an enhancement of approximately 30% with ZnO doping.

Keywords: Piezoelectric Coefficient, Polymer-Ceramic Composites, ZnO Doping, Hot Press Method.

ICEMSET-2026/FS/303

Deep Learning-Based Automated Roof Crack Detection for Structural Health Monitoring Using Computer Vision Techniques

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Abstract

Roof crack detection is an essential part of structural health monitoring systems as it helps to detect any cracks in the roof in time and helps in preventing the roof deterioration. The traditional visual inspection techniques are mostly time-consuming, subjective, and unsuitable for extensive infrastructure evaluations. In this paper, a deep learning-based automated roof crack detection system based on image analysis is presented. The images of roof surface with and without cracks were collected and preprocessed and augmented to enhance the robustness of the model. A CNN-based object detection model was designed and trained with the proposed model and the evaluation was performed based on accuracy, precision, recall, F1-score and Intersection over Union (IoU). The accuracy, precision, recall, and F1-score were 96.4%, 96.7%, 96.1%, and 96.4%, respectively, in the experimental results, which exhibited excellent detection performance. The comparative study was conducted with the Faster R-CNN, YOLOv5, YOLOv8 and Swin Transformer models, which further validated the proposed model. The results suggest a reliable, efficient, and scalable approach towards automated roof crack inspection and structural condition assessment using the developed approach.

Keywords: Roof crack detection, Deep learning, Structural health monitoring, Computer vision, YOLO, Image-based inspection.

ICEMSET-2026/FS/304

Computational Analysis of Thermal Response Characteristics for Defect Identification in Concrete Structures

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Abstract

Infrared thermography is becoming a useful non-destructive evaluation method to identify substructure defects in concrete structures. A 2-D finite difference heat transfer model coupled with Monte Carlo uncertainty analysis is used in this study to explore the detectability of defects. The simulated subsurface defects have various depths (from 10 to 50 mm) and diameters (from 15 to 45 mm) to analyze the influence of these defects on the thermal contrast, diffusion length, and detection probability. In addition, the uncertainty of thermal conductivity, depth of defects, and concrete density were estimated from 10,000 simulation runs of Monte Carlo simulations. Results showed a significant drop in thermal contrast and diffusion length with depth of the defects and an increase in detectability of the defects with the diameter of the defects. The highest detection probability of 96.78 % was achieved when the defect size was shallow (10 mm) and with a size diameter of 45 mm while the lowest probability of 46.43 % was obtained for a deep defect of (50 mm) and diameter of defect size (15 mm). The results showed that the defect geometry and material variation are very important to be taken into consideration for infrared thermographic inspection and reliable evaluation of defects of concrete structures, a simulation-based tool was designed to assess the defects.

Keywords: Infrared thermography, Finite difference method, Monte Carlo simulation, Subsurface defect detection, Thermal contrast analysis, Non-destructive evaluation.

ICEMSET-2026/FS/305

Performance assessment and optimization of gate all around junctionless nanotube MOSFET based biosensor

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Abstract

This manuscript proposes the gate all around junctionless nanotube MOSFET (GAA JL NT MOSFET) for biosensors applications using dielectric-modulation and gate underlap technique. The sensitivity of the GAA JL NT MOSFET will be assessed by immobilizing the different biological molecules such as lipids, biotin, uricase, protein, Gox, streptavidin, uriease, zein etc. in the cavity region created under the gate electrode and source and drain oxide. The sensitivity analysis will be done by varying the relative permittivity of the different biomolecules and design parameters of biosensor device. The sensitivity of the biosensor can be measured in terms of drain current (ID), threshold voltage (VTH), subthreshold slope (SS), transconductance (gm), threshold voltage (VTH), and ION/IOFF ratio. The proposed device structure has capability to reduce the leakage currents and high sensitivity biosensor design for future nanotechnology.

Keywords: GAA, Junctionless, Threshold Voltage, Biosensor, Nanotube.

ICEMSET-2026/FS/312

Influence of Man, Machine, Material and Method on 3-D Printing: Nurturing the Mankind with AI Embedded Domains

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Abstract

Present era is meant for the ‘Survival of the Fittest’. It has an impact, directly or indirectly, on all the spheres of our life. It is a systematic and comprehensive development. It tells us about various systems that are being taken up by scientists for the purposes of social upliftment. It also makes way for different emerging areas. It has an association with Food industry also. The concept of 3-D Printing is extensively being used by Food industry. In 3-D Printing, the object is being created by the application of a moving head that moves in any direction under controlled mechanism. One end of the moving head is essentially connected with Ink supply or Food material supply. The second end of the moving head is an Ink-jet nozzle spray head. In broader sense, the working of a 3-D Printing machine starts with Ink or food material supply. The Ink or food material will be supplied to the moving head. Further the moving head will deposit layers of the Ink or food material in microns, with the help of an Ink-jet nozzle spray head. The pressures at the Ink-jet nozzle spray head, the thickness of the Ink or food material to be deposited, and the dimensions of the final object to be created will determine the time required to complete the task. The recent example of applications of 3-D Printing in Food Industry is National Aeronautics and Space Administration. Gone are the days when NASA used to provide food packets to the Astronauts. Now, with the help of a 3-D Printing machine, the Astronauts can prepare their food by themselves in space/Rocket vehicles.

Keywords: Three-dimensional Printing, Food Industry, Replica, Energy, Ink, Material.

ICEMSET-2026/FS/314

Valorization of Pod-Based Biomass Residues into Sustainable Solid Fuel Briquettes: A Response Surface Methodology (CCD) Optimization Approach

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Abstract

Rising fossil fuel is a dependence and also an improper disposal of agricultural residues which have an intensified the need for renewable solid fuels. This study investigates the fuel briquettes prepared from five pod-based biomass materials—Bauhinia variegata, Mesquite, peanut pods, survey pods, and Albizia lebbeck pods in which using starch as a binder. The materials were characterized using different analysis which are FTIR, XRD, SEM, and TG/DTA, followed by proximate and ultimate analysis. Briquette performance was evaluated through a calorific value, porosity, water absorption, shatter index, compressive strength, tumbling test, and also degree of densification. Response Surface Methodology (CCD) was computational optimization technique also applied to optimize process parameters and then compared predicted versus experimental results of pods. Findings of these indicates pod-derived briquettes offer a viable and also a biodegradable alternative to charcoal and firewood for cooking and industrial heating applications.

Keywords: Pod biomass; fuel briquettes; starch binder; calorific value; Response Surface Methodology; waste-to-energy.

ICEMSET-2026/FS/324

Optical Proprties of Dy^{3+} Doped Zinc Tellurite Glasses for photonic devices

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Abstract

Dy^{3+}-doped zinc tellurite glasses of composition TeO_2–ZnO–Na_2O–x Dy_2O_3 (x = 0.5-1.5 in mol%, TZND) were prepared by the conventional melt-quench technique and characterized using XRD, DSC, UV–Vis–NIR absorption, excitation, and photoluminescence spectroscopy. Also, its physical parameters were evaluated, revealing the high density (4.875 g/cm³), low molar volume (28.02 cm³/mol), and high oxygen packing density (89.14 mol/L) indicating a compact and well-connected glass network. The absorption spectrum exhibited seven characteristic Dy^{3+}4f–4f transitions, with the strongest excitation band at 453 nm. Under blue excitation, $Dy^{3+}$is expected to produce strong blue (~484 nm) and yellow (~574 nm), along with weak red (~660 nm) emissions. The yellow-to-blue intensity ratio can provide information on local site asymmetry. These properties suggest potential applications in solid-state lighting and visible photonic devices.

Keywords: Dy^{3+}ions; Zinc tellurite glasses; XRD; photoluminescence; energy-level diagram; white-light emission.

ICEMSET-2026/FS/354

Trust-Weighted Price Signals: A Hybrid Framework for Strengthening Market Linkages and Price Discovery for Smallholder Farmers

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Abstract

This study proposes a hybrid framework titled Trust-Weighted Price Signals to strengthen market linkages and improve price discovery for smallholder farmers. The framework integrates digital technologies, real-time

market information, data analytics, and trust-based mechanisms to provide reliable and transparent agricultural price signals. By incorporating information from farmers, traders, agricultural markets, and digital platforms, the proposed approach aims to reduce information asymmetry, enhance price transparency, and support informed marketing decisions. Trust-weighted mechanisms help assess the reliability and credibility of price information, minimizing the influence of misleading or inconsistent signals. The framework offers potential pathways towards equitable market access, improved farmer bargaining power, and sustainable agricultural development.

ICEMSET-2026/FS/355

A Smart Multilevel Inverter-Based System for Renewable Energy Integration

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Abstract

Smart energy systems require efficient, reliable, and power-quality-oriented power conversion technologies for integrating renewable energy sources, energy storage systems, and electric vehicles. Multilevel inverters (MLIs) have emerged as a promising solution due to their capability to generate high-quality output voltage with reduced harmonic distortion and lower switching losses. This paper presents a smart system based on multilevel inverter technology for efficient energy management and improved power quality. The proposed system incorporates intelligent control strategies to regulate inverter operation according to variations in load demand and renewable energy generation. The multilevel structure enables reduced voltage stress on semiconductor switches, improved waveform quality, and better utilization of available energy sources. The smart control system can also support real-time monitoring, fault detection, and adaptive power management. The proposed approach is suitable for smart grids, renewable energy integration, electric vehicle charging, and micro grid applications. Simulation-based analysis can be used to evaluate voltage quality, harmonic distortion, efficiency, and dynamic performance under different operating conditions.

Keywords: Multilevel Inverter (MLI), Smart Energy System, Intelligent Control, Renewable Energy Integration, Power Quality, Harmonic Distortion, Smart Grid, Energy Management, Electric Vehicles, Micro grid.

ICEMSET-2026/FS/357

Fuel Chemistry-Mediated Microstructural and Functional Modulation of α-Fe_2O_3 Nanoparticles: A Comparative Study of Citric Acid and Urea

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Abstract

Iron oxide (Fe_2O_3) nanoparticles are of wide interest for catalytic, magnetic, sensing, and environmental applications owing to their natural abundance, low toxicity, thermal stability, biocompatibility and tunable physicochemical properties. Solution Combustion Synthesis (SCS) is a rapid, cost effective repeatable and energy-efficient route to prepare nanocrystalline hematite (α-Fe_2O_3) in which the choice of fuel strongly influences the resulting structure and properties. This study presents an integrated, multi-technique comparison of α-Fe_2O_3 nanoparticles synthesized by SCS using ferric nitrate as the oxidizer with urea and citric acid as fuels in stoichiometric oxidizer-to-fuel ratios. X-ray diffraction analysis revealed pronounced fuel-dependent differences in crystallite size, microstrain, internal stress and dislocation density. Scanning electron microscopy analysis is used to explore a comparative morphology variation. Fourier-transform infrared and Raman spectroscopic analysis independently confirmed the formation of phase-pure hematite in both samples. UV–Vis absorption spectroscopy exhibited an absorbance profile. Reflectance spectrum was also studied from which band gap was calculated using Kubelka Munk method. The band gap energy values were found to be consistent

with nanostructured hematite. Vibrating sample magnetometry (VSM) revealed narrow, weakly ferromagnetic hysteresis loops for both samples with a trend that correlates directly with their contrasting crystallite size and defect density. Altogether, the results demonstrate that fuel selection during SCS is a single, cost-effective parameter that simultaneously governs the structural, vibrational, optical, and magnetic properties of α-Fe_2O_3 nanoparticles.

ICEMSET-2026/FS/360

Optimization of drip irrigation scheduling based on ETc using FAO CROPWAT 8.0 for higher onion yield and water productivity

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Abstract

A field experiment was conducted during 2024–25 at the Soil Science Research Farm, CCS Haryana Agricultural University, Hisar, Haryana, to evaluate the effect of different irrigation levels on irrigation water use, total water use, water productivity and bulb yield of onion under drip irrigation. Three irrigation levels were evaluated: I_1 (80% ETc), I_2 (100% ETc) and I_3 (120% ETc). Crop evapotranspiration and irrigation requirements were estimated using FAO CROPWAT 8.0, and irrigation water was applied through a drip irrigation system. Irrigation water applied was 26.35, 34.55 and 42.75 cm under I_1, I_2 and I_3, respectively. Effective rainfall remained 6.45 cm across all treatments, resulting in total water use of 32.80, 41.00 and 49.20 cm, respectively. Total water productivity was 1.10, 1.07 and 0.99 kg m^{-3} under I_1, I_2 and I_3, respectively. Bulb yield increased with increasing irrigation level, with the minimum yield of 240.4 q ha^{-1} recorded under I_1 (80% ETc), followed by 282.6 q ha^{-1} under I_2 (100% ETc), and the maximum yield of 314.0 q ha^{-1} under I_3 (120% ETc).

Keywords: ETc; FAO CROPWAT 8.0; Irrigation Scheduling; Bulb Yield; Water Productivity.

ICEMSET-2026/FS/361

Metrology and its Significance for Precision Measurement of AC Power & Energy

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Abstract

Metrology is the science of measurement, embracing both theoretical and experimental determinations at any level of uncertainty. It establishes a reference point to ensure accuracy of measurements, facilitating fair trade in a domestic economy as well as international trading in global market through harmonized measurement standards. Precision measurements ensure that any material or product meet the specified standards and regulatory requirements. In the field of AC power & energy, the accurate and reliable measurement of energy is one of the crucial aspects for development of any country. Energy meters are utilized to record the amount of energy consumption and these energy meters are tested against reference electrical standards of AC power & energy. The national standards are traceable to international standards that are realized through International System of Units (SI). Metrological testing of energy meters ensures accurate billing and regulatory compliance for these energy meters before their installation in the field.

Keywords: Metrology, Precision measurement, National Standards, Reference Standards, Energy meters.

ICEMSET-2026/FS/365

Transforming knowledge systems for life on Earth: Visions of future systems and how to get there

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Abstract

Formalised knowledge systems, including universities and research institutes, are important for contemporary societies. They are, however, also arguably failing humanity when their impact is measured against the level of progress being made in stimulating the societal changes needed to address challenges like climate change. In this research we used a novel futures-oriented and participatory approach that asked what future envisioned knowledge systems might need to look like and how we might get there. Findings suggest that envisioned future systems will need to be much more collaborative, open, diverse, egalitarian, and able to work with values and systemic issues. They will also need to go beyond producing knowledge about our world to generating wisdom about how to act within it. To get to envisioned systems we will need to rapidly scale methodological innovations, connect innovators, and creatively accelerate learning about working with intractable challenges. We will also need to create new funding schemes, a global knowledge common, and challenge deeply held assumptions. To genuinely be a creative force in supporting longevity of human and non-human life on our planet, the shift in knowledge systems will probably need to be at the scale of the enlightenment and speed of the scientific and technological revolution accompanying the second World War. This will require bold and strategic action from governments, scientists, civic society and sustained transformational intent.

Keywords: Sustainability science; Epistemology; Transformation; Social-technical transitions; Knowledge; Climate and energy research.

ICEMSET-2026/FS/384

Sensor-based smart irrigation scheduling for improving wheat productivity in North-West Haryana

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Abstract

Efficient irrigation scheduling is essential for improving wheat productivity and optimizing the use of scarce water resources in the agro-ecosystems of North-West Haryana. A field experiment was conducted during *Rabi* 2023–24 at Soil Research Farm, CCS Haryana Agricultural University, Hisar, to evaluate the effect of sensor-based irrigation scheduling on growth, yield attributes and grain yield of wheat. Irrigation was scheduled at 20, 30 and 40% depletion of available soil moisture (SMD) in the root zone. The results showed that irrigation at 20% SMD recorded the highest plant height (101.00 cm), effective tillers (70.20 m^{-1}), spike length (11.64 cm), grains per spike (62.39), 1000-grain weight (43.02 g) and grain yield (55.49 q ha^{-1}). Irrigation at 30% SMD resulted in intermediate values, with a grain yield of 51.47 q ha^{-1}, whereas irrigation at 40% SMD recorded the lowest grain yield (47.57 q ha^{-1}). The improvement in grain yield under frequent irrigation was associated with better yield attributes. The findings indicate that maintaining soil moisture at lower depletion levels through sensor-based scheduling can enhance wheat productivity under limited irrigations.

Keywords: Wheat, Sensor-Based Irrigation, Irrigation, Scheduling, Soil Moisture Depletion.

ICEMSET-2026/FS/387

Development of a Low-Cost Biodegradable Cellulose Paper Based Electronic Circuit

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Abstract

This work presents a low-cost LED circuit fabricated on a biodegradable cellulose paper substrate using a hand-drawn graphite conductor. A U-shaped graphite trace was formed by repeated pencil shading, and a red LED and current-limiting resistor were connected in series using pressure contacts rather than soldering. When powered by a DC source, the LED produced steady and continuous illumination. This observation confirms that the deposited graphite formed an electrically continuous path across the paper surface and carried sufficient current for low-power operation. The trace also contributed series resistance because graphite is less conductive than metallic wiring. Despite contact resistance at the component interfaces, the circuit remained functional without thermal processing or permanent conductive adhesives. The experiment demonstrates a simple method for constructing and validating a working paper-based LED circuit with inexpensive, readily available materials.

Keywords: Cellulose paper; Graphite conductor; Paper circuit; Solderless connection.

ICEMSET-2026/FS/389

Beyond Single-Junction Limits: Engineering the Perovskite/Si Tandem Revolution

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Abstract

The unsustainable depletion of fossil fuels and associated severe environmental degradation necessitate a rapid global transition towards energy sources. Among clean alternatives, solar photovoltaics are the most promising solution because solar irradiance is globally accessible. Solar cells operate by directly converting incident solar photons into electricity via the photovoltaic effect across semiconductor p-n junctions. Traditional single-junction solar cells utilize a semiconductor absorber to capture the solar spectrum. However, single-junction devices suffer fundamental efficiency penalties, primarily driven by thermalization loss of high-energy photons and non-absorption of sub-bandgap photons. Under AM1.5G_1Sun illumination, these spectral losses restrict single-junction absorbers to a maximum thermodynamic Shockley-Queisser limit of ~33.7%. To overcome this single-junction limitation, tandem solar cell architectures stack multiple absorbers with complementary bandgaps to partition and convert the solar spectrum more efficiently. In his thermodynamic study, De Vos utilized detailed balance contour plots to demonstrate that ideal dual-junction tandems require top and bottom bandgaps around ~1.7 eV and ~1.1 eV, respectively. Monolithic perovskite/silicon tandem devices closely mirror this optimum by pairing a high-bandgap metal-halide perovskite (~1.68 eV) with a low-bandgap crystalline silicon subcell (~1.12 eV). The 2T monolithic tandem solar cell of $CsPbI_3$/Si produces a PCE of 34.05% through SCAPS-1D simulation.

Keywords: Perovskite; Silicon; Tandem Solar Cell; Recombination; Defect;

ICEMSET-2026/FS/393

Design and Synthesis Colorimetric Organic Sensor for Selective Detection of biological important Fluoride and Acetate ions

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Abstract

Designed and synthesized organic sensor R for the detection of fluoride and Acetate ion. Receptor R showed high selectivity towards F^- and Aco^- ions due to the presence of electron withdrawing (NO_2). Upon addition of F^- and AcO^- ion receptor R displayed a colour change from pale yellow to brown colour. Recptor R showed a

detection limit of 1.2 ppm with binding constant of 4.37×10^{4} M. In addition to, the bathochromic shift of 97 nm and 96 nm upon binding with fluoride and acetate ion which is much less than WHO detection limit of 1.5 ppm. The behavior of receptor R1 towards F^{-} ion was investigated using UV-Vis titration and ^{1}H NMR titrations. ^{1}H NMR studies confirmed a 1:1 binding ratio between the receptor and F^{-} ion. The interaction initially involves strong hydrogen bonding, followed by deprotonation due to the presence of a strong electron-withdrawing NO_2 group, which increases the acidity of the NH proton."

Keywords: Colorimetric Sensor, Real life application, Hydrogen bonding, aqueous solution, Acetate ion.

ICEMSET-2026/FS/397

Functional Nanomaterials for Sustainable IC Engines: Performance and Emission Characteristics of TiO_2 and CeO_3-Based Nanofuels

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Abstract

Functional nanomaterials are emerging as promising additives for improving the performance and environmental sustainability of internal combustion (IC) engines. This study explores the potential of titanium dioxide (TiO_2) and cerium oxide (CeO_3)-based nanofuels as advanced fuel formulations. The incorporation of metal oxide nanoparticles can influence fuel properties, enhance combustion efficiency, improve heat transfer, and promote more complete fuel oxidation. The investigation focuses on key engine performance parameters, including brake thermal efficiency, specific fuel consumption, and exhaust emissions such as carbon monoxide, hydrocarbons, and nitrogen oxides. The comparative assessment of these nanofuels highlights their potential to improve combustion characteristics, reduce harmful emissions, and contribute to cleaner and more energy-efficient IC engine technologies.

ICEMSET-2026/FS/400

Molecular Ferroelectricity in Purely Organic Imidazole Derivatives

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Abstract

Although conventional inorganic ferroelectrics have been extensively explored, purely organic ferroelectric materials have recently garnered great interest due to their lightweight, low toxicity, solution processability, and environmental friendliness. In our continued effort to discover above-room temperature ferroelectricity in single-component organic molecular material, here we report the cases of (1) 4,5-diiodo-2-phenyl-1H-imidazole and (2) 8-(4-X)-7H-acenaphtho[1,2-d] imidazoles, where X=F, Cl, Br, I. While compound 1 crystallizes in a polar space group *Aba2*, the halo derivatives of 2 crystallize in the polar space group $Pca2_1$. The halo derivatives are isomorphous and isostructural. These compounds consisting of an enamine unit form asymmetric N-H…N hydrogen bonds and experience π-bond dipole switching due to proton transfer, leading to the generation of spontaneous polarization (P_s). They possess high thermal stability and display notable second harmonic generation activity. In-crystal measurements on these lightweight materials exhibited excellent dielectric properties and resulted in a typical well-rectangular *P-E* hysteresis loop with a low coercive field and reasonable P_s values. These purely organic ferroelectric materials may find applications in memory devices.

Keywords: Organic Materials, Above-room temperature ferroelectricity, ecofriendly, Isomorphous and Isostructural, Asymmetric hydrogen bonding, Second harmonic generation.

ICEMSET-2026/FS/401

Geochemical simulation of corrosion during water injection operations in the Haoud Berkaoui oil field, southeastern Algeria

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Abstract

This study investigates the corrosion of steel equipment used in petroleum operations during water injection activities, with a particular focus on the Haoud Berkaoui field (South Algeria). The main objective is to geochemically simulate the impact of mixing formation water with injected water on corrosion-related processes by calculating the saturation indices of selected iron-bearing minerals commonly encountered in oilfield environments and estimating the amounts of these minerals that may precipitate. Three different scenarios were considered, corresponding to varying temperature and pressure conditions. The results indicate that hematite is the only mineral showing a clear tendency toward precipitation, with positive saturation indices under all investigated scenarios. Its predicted concentration also increases with increasing volumes of injected water. In contrast, siderite is predicted to occur only under laboratory conditions (25 °C and 1 bar), suggesting that the temperature and pressure conditions prevailing in the field inhibit its formation. Overall, the geochemical simulations indicate that water injection does not significantly promote corrosion through the precipitation of the investigated iron-bearing minerals.

Keywords: Geochemical simulation; Corrosion; Water injection; Formation water; Haoud Berkaoui.

ICEMSET-2026/FS/402

Engineering CuS/TiO_2 Mesoporous Nanostructures for Enhanced Visible-Light Photocatalytic Performance

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Abstract

CuS-activated mesoporous TiO_2 nanostructures were successfully synthesized through a facile hydrothermal approach to enhance the visible-light photocatalytic performance of TiO_2. The incorporation of CuS, a narrow band-gap semiconductor, with mesoporous TiO_2 forms a heterojunction that significantly extends light absorption into the visible region while promoting efficient separation and transport of photogenerated electron–hole pairs. The mesoporous architecture provides a high specific surface area, abundant active sites, and improved adsorption of pollutant molecules, thereby enhancing photocatalytic efficiency. The synthesized nanostructures were characterized using X-ray diffraction (XRD), field-emission scanning electron microscopy (FESEM), transmission electron microscopy (TEM), Raman spectroscopy, X-ray photoelectron spectroscopy (XPS), UV–Visible diffuse reflectance spectroscopy (UV–DRS), Brunauer–Emmett–Teller (BET) surface area analysis, and photoluminescence (PL) spectroscopy to investigate their structural, morphological, optical, and electronic properties. Photocatalytic activity was evaluated by the degradation of methylene blue under visible-light irradiation. Radical trapping studies further indicated that reactive oxygen species generated during photocatalysis play a key role in the degradation mechanism. The novelty of this work lies in the integration of CuS with mesoporous TiO_2 to construct a visible-light-active heterojunction photocatalyst that simultaneously exploits mesoporosity and CuS sensitization. Unlike conventional TiO_2 photocatalysts, the proposed nanostructure combines enhanced surface area, efficient charge-carrier separation, and broadened visible-light absorption in a single material, resulting in superior photocatalytic performance. This synergistic design provides an effective, stable, and environmentally benign strategy for the degradation of dye pollutants visible-light irradiation.

Keywords: Hydrothermal method, anatase TiO_2, methylene blue, photocatalytic activity.

ICEMSET-2026/FS/412

Continuous heat source dependence on thermomagnetic convection in a ferrofluid saturated porous medium

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Abstract

The present study examines thermomagnetic convection in a horizontal ferrofluid saturated porous layer under the influence of continuous internal heat sources. The lower boundary is taken to be rigid and subjected to a constant heat flux, while the upper boundary is rigid and held at a constant temperature. Three internal heat generation configurations are considered, namely, constant, exponential, and trigonometric. The linear stability theory, together with normal mode analysis, is employed to investigate the stability characteristics of the system. The resulting eigenvalue problem is solved numerically using the Galerkin weighted residual method. The results show that increasing the Darcy number and the magnetic number destabilizes the system under all three heating configurations, whereas increasing the viscosity ratio delays the onset of ferroconvection. The nonlinear magnetization parameter has a negligible effect on the system. The exponential heating produces the most stable flow motion, whereas constant heating is the least stable, with the critical Rayleigh number being highest for exponential heating and lowest for constant heating. The study examines the effects of continuous internal heating and magnetic fields on thermomagnetic convection in ferrofluid-saturated porous systems, with applications in magnetic cooling and heat exchangers. The present results show excellent agreement with previously published findings, validating the numerical method employed.

Keywords: Thermomagnetic convection; ferrofluid; Galerkin technique; continuous heat source; porous media.

ICEMSET-2026/FS/426

High-Efficiency $LaVO_3$ Mott-Insulator-Based Heterojunction PV Cell Simulation and Performance Optimization Using SCAPS-1D

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Abstract

The transition-metal oxide Mott insulator lanthanum vanadium oxide ($LaVO_3$) has garnered interest as a potential next-generation solar absorber because of its appropriate bandgap, excellent visible spectrum absorption, and chemical stability. This study uses the SCAPS-1D simulator to numerically study a heterojunction photovoltaic system that uses $LaVO_3$ as the absorber, Cu_2Te as the hole transport layer (HTL), and SnO_2 as the electron transport layer (ETL). Through adjustments to absorber thickness, carrier concentration, and charge transport layer characteristics, the suggested design (FTO/SnO_2/$LaVO_3$/Cu_2Te/Pt) was optimized. With an open-circuit voltage of 1.115 V, a fill factor of 89.62%, and a short-circuit current density of 37.38 mA/cm², theoretical studies show an efficiency of 37.38%. The optimized energy band alignment and decreased interfacial recombination are the main reasons for these values' significant improvement over previously documented $LaVO_3$-based devices. This work emphasizes the promise of Cu_2Te/$LaVO_3$/SnO_2 heterojunctions as a possible route for high-efficiency, lead-free perovskite-inspired photovoltaics, even though the efficiencies are based on perfect simulation assumptions.

Keywords: $LaVO_3$, Perovskite Solar Cells, SCAPS-1D, SnO_2, Cu_2Te, High Efficiency, Mott Insulator.

ICEMSET-2026/FS/448

AI-Based Livestock Health Monitoring: Predictive Analytics for Early Disease Diagnosis

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Abstract

This study aims to evaluate how artificial intelligence (AI) can support continuous livestock health monitoring and enable earlier disease diagnosis. It proposes an integrated methodological approach that combines machine learning, computer vision, and Internet of Things (IoT) sensors to collect and analyze physiological and behavioral indicators, including body temperature, heart rate, feed intake, movement, rumination, and milk production. Predictive models identify deviations from normal patterns, estimate potential health risks, and generate alerts for timely veterinary intervention. The expected outcomes include improved detection accuracy, reduced diagnostic delays, and more effective data-driven livestock management. The study also assesses practical implementation challenges, including data quality, sensor costs, connectivity limitations, and model reliability. By enabling earlier and more informed responses to emerging health problems, AI-based monitoring can improve animal welfare, reduce preventable economic losses, increase farm productivity, and promote sustainable livestock production.

Keywords: Artificial Intelligence, Livestock Health, Predictive Analytics, Early Disease Diagnosis, Machine Learning, IoT.

ICEMSET-2026/FS/449

Need of Farmer-Friendly Smart Spectral Sensors for Real-Time Crop Health Monitoring and Precision Agriculture

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Abstract

Agriculture is entering a new era of digital transformation, yet the adoption of advanced sensing technologies remains limited due to high costs, complex operation, and poor interpretability for end-users. There is a growing need for user-friendly, portable, and affordable sensors capable of directly identifying crop and soil conditions in real time. This paper highlights the use of spectral sensors capable of diagnosing water stress, chlorophyll content, plant health (NDVI, EVI etc) by field portable spectroradiometer that is used in agricultural research. The instrument uses solar light reflection in all wavelengths and different algorithms helps identifying different property of plants. These instruments are better used in scientific research but not helpful for farming community. The paper emphasizes the development of low cost, hand held and easily operable small smart devices that can reach to farmer to help him in assessing major problematic issues in farming such as nitrogen-phosphorus-potassium (NPK) deficiencies, soil quality, nutrient status, water flow dynamics, and early insect-pest infestations through physical or color and spectral pattern interpretation. Integration of multispectral and hyperspectral sensing with artificial intelligence can enable rapid conversion of complex spectral signatures into simple user-readable outputs such as nutrient alerts, stress indices, and crop health indicators. More emphasis is placed on developing direct-contact and touch-based crop sensing platforms that can identify plant properties at the leaf, stem, fruit, and root levels without extensive laboratory analysis. Such sensors may combine optical, capacitive, moisture, electrochemical, and bio-inspired electronic sensing principles to facilitate instantaneous crop diagnostics. The moto to the abstract is to attract the sensor developers towards agricultural stream and to show what they actually need.

Keywords: Precision Agriculture, Spectral Sensors, Multispectral Imaging, Crop Stress Detection, NPK Sensing.

ICEMSET-2026/FS/461

An Efficient Technique for Absorbing and Collecting Solar Energy: A Parabolic Concentrating Solar Water Heater

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Abstract

This paper concerns with an experimental study on the overall thermal performance of a Parabolic Concentrating solar water heater. The exprements were conducted using water as the working fluid on three different sunny days. Solar energy is collected and stored in the water storage tank during the time period 9:00 h to 15:00 h at three different mass flow rates (0.066, 0.074 and 0.081kg/s). The thermal performance of solar heater used in the present study was evaluated on the basis of hourly solar energy collected, hourly energy stored, Charging efficiency and overall thermal efficiency. The peak overall thermal efficiency is observed at noon at a mass flow rate of 0.081kg/s. The experimental results reveal that the overall performance parameters are highly influenced by incident solar radiation.

Keywords: Parabolic Concentrating solar water heater; Solar Intensity; Hourly energy collected; Hourly energy stored; Overall thermal Efficiency.

ICEMSET-2026/FS/466

100 MeV Ag Ion Irradiation Induced Structural and Morphological Modifications in CdZnTe Thin Films

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Abstract

Ion irradiation in the MeV range, known as Swift Heavy Ion (SHI) irradiation, is recognized as a powerful tool to produce controlled defects, structural disorder and strains in the thin films. This leads to modification of the structural, morphological and optical properties of the thin films. In the present investigation, 100 nm thick films of CdZnTe are deposited on cleaned glass substrates by the thermal evaporation method. The deposited films are later irradiated by 100 MeV Ag ions with fluence of 1×10^{12} ions/cm^2 and 5×10^{12} ions/cm^2. The X- ray diffraction (XRD) technique employed for structural characterization indicates that the films are transformed to amorphous phase after Ag ion irradiation. Atomic Force Microscopy (AFM) is employed to understand Ag ion-induced surface modifications. Grain fragmentation and changes in the distribution of grain sizes are shown by AFM analysis. Optical studies using UV-Visible analysis indicate the rise in energy band gap.

Keywords: SHI, CdZnTe, AFM, XRD, UV-Vis.

ICEMSET-2026/FS/482

Wide-Bandgap Semiconductor Materials for Next-Generation EV Battery Management Systems: Opportunities and Challenges

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Abstract

The rapid growth of electric vehicles (EVs) demands battery systems with higher efficiency, faster charging and longer lifespan. Wide-bandgap (WBG) semiconductors - silicon carbide (SiC) and gallium nitride (GaN) - are

emerging as key enablers for EV battery management and power conversion due to their superior breakdown voltage, thermal conductivity and switching frequency compared to conventional silicon. The abstract reviews the role of WBG materials in onboard chargers, DC-DC converters, and battery monitoring circuits, highlighting reduced switching losses, compact thermal management and improved system efficiency. Material-level considerations such as defect density, thermal stability and packaging challenges affecting reliability under harsh automotive conditions are discussed. Emerging materials, including gallium oxide and diamond, are also examined as future candidates. Finally, research directions are identified for integrating WBG devices with intelligent battery management systems, emphasizing cost reduction and manufacturing scalability for widespread EV adoption.

Keywords: Wide-bandgap semiconductors, Silicon carbide (SiC), Battery management system (BMS), Electric vehicle (EV).

ICEMSET-2026/FS/486

Numerical study for the preparation of a bio-based membrane using the Flory-Huggins, Krieger-Dougherty model

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Abstract

This work focuses on the theoretical study of a bio-based membrane developed using polyvinyl alcohol (PVA), citric acid, sodium chloride (NaCl), and olive pomace, intended for water treatment applications. It aims to describe the scientific principles governing the design of this membrane, highlighting the specific role of each of its constituents as well as the physicochemical phenomena occurring during its formation and operation. This work also presents the main mechanisms involved in pollutant separation, particularly membrane filtration and adsorption, before addressing the theoretical modeling of the system using the Flory-Huggins, Krieger-Dougherty, and Response Surface Methodology (RSM) approaches. Finally, the theoretical parameters likely to influence the membrane's performance are analyzed to provide a solid scientific basis for the experimental study presented in the following chapters.

Keywords: Bio-based membrane; polyvinyl alcohol (PVA); olive pomace; Flory-Huggins; Krieger-Dougherty.

ICEMSET-2026/FS/491

A Research towards the values of Universal Constants μ_0 and ε_0

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Abstract

At the macroscopic scale, electricity and magnetism manifests itself in many a familiar phenomenon that give the force its name. Rather remarkably, a full description of the force of electromagnetism is contained in a rather simple yet elegant set of four relations; called the Maxwell's Equations. These four vector equations encompass all the phenomenon relating to electricity and magnetism as well as what connects them. Till date, the Maxwell's Equations remain incomplete without the presence of seemingly arbitrary physical constants μ_0 and ε_0. Thus, there occurs a necessity to study the presence of these constants in order to better understand Maxwell's Equations and hence it is of significance that we classically derive Maxwell's Equations that tells us the existence of these constants and prove their existence empirically. Theoretical value for Magnetic Permeability for Free Space is 0=1.25663706127×10-6 T.m/A. The Magnetic Permeability for Free Space at Constant Current Component is 0=1.25614441596219×10-6 T.m/A. The Magnetic Permeability for Free Space at Constant Length Component is 0=1.25007861700157×10-6 T.m/A. The Theoretical Value for Dielectric Permittivity for Free Space is 0=8.8541878188×10-12 F/m. The Dielectric Permittivity for Free Space at Constant Area Component is;0=8.89205026122884×10-12 F/m. The Dielectric Permittivity for Free Space at Constant Distance Component is;0=8.8764880952381×10-12 F/m. This paper aims to theoretically obtain

Maxwell's Equations as well as to experimentally obtain the values of universal constants; the vacuum magnetic permeability constant (μ_0) and the vacuum dielectric permittivity constant (ε_0) up to a significant degree of accuracy as a means to verify the equations. $\mu_0=1.25663706127\times10^{-6}$ T. m/A and $\varepsilon_0=8.85418781881\times10^{-12}$F/m.

ICEMSET-2026/FS/497

Evaluation of Radiation Exposure Risks from Water and Sediment Samples in the Tehri Dam Reservoir, Uttarakhand, India

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Abstract

The present study aims to assess the radiological characteristics and associated health risks from water and sediments samples in the Tehri Dam Reservoir, Uttarakhand, India. The reservoir is an important source of water for domestic, agricultural, and hydropower purposes, making the evaluation of naturally occurring radionuclides relevant for environmental and public-health monitoring. Water and sediment samples collected from representative locations of the reservoir will be analyzed for uranium, heavy metals and radionuclides such as ^{226}Ra, ^{232}Th, and ^{40}K using ICP-MS and Gamma Ray Spectrometric (GRS) techniques. Furthermore, the spatial analysis has been performed to check the spatial variability throughout the study region. The dose wereb then also calculated to the inhabitants from the measured values of radionuclides and uranium contents for the different age groups. These findings will provide baseline data in the studied area and enhance the radiological database as well as measurement validation for future research in the similar geological settings.

Keywords: Tehri Dam, Water Quality, Heavy metals, Garhwal Himalaya, ICP-MS, GRS.

ICEMSET-2026/FS/514

Research on the Application of Distributed Photovoltaic Power Generation Systems in Architectural Design

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Abstract

The application of distributed photovoltaic (PV) power generation systems in architectural design is becoming increasingly mature. This paper examines the composition, key design considerations, and grid-connection schemes of distributed PV systems for civil buildings. By analyzing the design of a PV system for a specific residential complex, the study highlights the advantages and benefits of grid-connected distributed PV systems. It proposes feasible design approaches for integrating PV systems into architectural projects—covering both electrical and grid-connection designs—with the aim of providing a reference for the further promotion and application of distributed PV systems in building design.

Keywords: Architectural Design; Distributed Photovoltaic System; Grid-connection Design.

ICEMSET-2026/FS/538

Assessment of Mineral Nutrition across the Soil–Plant–Animal–Human Continuum in Village Ludas, Haryana

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Abstract

Mineral deficiencies and imbalances in soil can disrupt the soil–plant–animal–human continuum by affecting crop growth, fodder quality and mineral transfer through the food chain. This may lead to poor livestock productivity and nutritional disorders in humans and animals. The present study was conducted to quantify the role of nutrients at each level of soil-plant-Animal-human continuum in village Ludas of district Hisar of Haryana. From this village, 22 soil and plant samples, 25 of feed, 18 of milk, 25 of hair and blood serum of animal and 25 of human blood samples was collected from the selected farmers and analyzed for P, Ca, Zn, Fe, Mn and Cu content. The results showed was based on critical levels of mineral nutrient and nutrient deficiency was calculated in percentage. In soil samples iron was deficient in 9% of samples followed by P (4.55%). In case of plant samples, deficiency of P was observed in 32 % of samples followed by Cu (27 %). Whereas, in case of feed samples, Fe (28 %), Mn (24%), Cu (16%) and P (8 %) deficiency was found. In animal hair and milk samples, Zn was found deficient in 40% of hair samples followed by Cu (16 %) and Mn (8 %) whereas, in case of milk samples 50% and 22% sample were deficient in Zn and Cu, respectively. In animal blood serum samples 64% sample were found deficient in Zn followed by 20% in P. The study revealed the positive and significant correlation values of 0.43 for Ca in soil- plant and 0.61 for P in plant-milk.

Keywords: Soil, Plant, Animal, Human and Continuum.

ICEMSET-2026/FS/539

Merging Specialists: Conciseness and Error-Detection

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Abstract

This paper aims to check whether two specialists, namely Error-Detection specialist and conciseness specialist, fine-tuned from the same base model can merge and maintain their skills, without retraining. I performed the experiment on Gemma-3 1B and Qwen2.5 1.5B and merged the specialists using linear, SLERP, TIES, DARE-TIES and task arithmetic. In Gemma, DARE-TIES correctly indicated root error 32.6% of the time, as compared to the fine-tuned error detection specialist which indicated 30.2% of the time. In Qwen, DARE-TIES indicated it 26.7% of the time, compared to 17.7%. DARE-TIES also had conciseness line F1 at around 99%. Linear and SLERP collapsed into conciseness and lost almost all root error detection skill. Thus, the proposed method can use sign-aware methods such as TIES and DARE-TIES to merge fine-tuned models while maintaining skills without the need to retrain.

Keywords: Model merging; LoRA fine-tuning; DARE-TIES; Error detection; Conciseness.

ICEMSET-2026/FS/543

Mid-Infrared Photonics with Chalcogenide and Tellurite Glasses: Sensing, Emission, and Frequency Conversion

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Abstract

Chalcogenide glasses containing sulfur, selenium, and tellurium exhibit broad NIR–MIR transparency, high refractive indices, and low phonon energies, making them promising for infrared photonics and gas sensing. Rare-earth-doped chalcogenide glasses and fibers are investigated for CO_2 and CH_4 detection using optical absorption, photoluminescence, lifetime measurements, and Judd–Ofelt analysis. Additionally, Tm^{3+}/Ho^{3+}-doped tellurite glasses prepared in OH-free environments offer excellent glass-forming ability, high rare-earth solubility, and favorable spectroscopic properties. Their luminescence supports NIR/MIR temperature sensing and gas detection. These studies highlight the potential of compositional and spectroscopic optimization for advanced MIR sensing and photonic devices.

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Keywords: Chalcogenide glasses; Tellurite glasses; Mid-infrared photonics; Rare-earth luminescence; Optical gas sensing.

ICEMSET-2026/FS/550

Seasonal incidence of *Tetranychus* spp. on vegetable crops in relation to weather factors

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Abstract

A field study was conducted during year 2025–26 at the Entomology Research Farm and Vegetable Farm, CCSHAU, Hisar, Haryana, to identify phytophagous mites infesting vegetable crops and assess the seasonal incidence of predominant species in relation to abiotic factors. Surveys revealed that *Tetranychus* spp. was the most prevalent phytophagous mite species attacking vegetable crops. Weekly monitoring from SMW 10 of year 2025 to SMW 18 of year 2026 showed considerable population fluctuations, with a major peak of 36.6 mites per 2 cm² leaf area during SMW 23, followed by a decline during the monsoon. A second peak of 13.6 mites was recorded during SMW 43. Mite incidence was positively correlated with maximum (r = 0.630) and minimum temperatures (r = 0.527), but negatively correlated with morning relative humidity (r = −0.608). Multiple regression indicated that weather parameters explained 48.1 per cent of population variation (R^2 = 0.481). Warm, relatively dry conditions favored mite population buildup.

Keywords: Phytophagous mites, *Tetranychus* spp., vegetable crops, seasonal incidence, abiotic factors, multiple regression.

ICEMSET-2026/FS/551

Sensor-Aware LLM Interface for Natural Language Querying of IoT Environmental Monitoring Databases

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Abstract

Low-cost Internet of Things (IoT) sensors generate large volumes of environmental data, yet non-technical users struggle to extract useful information from these databases, and faulty readings can lead to misleading conclusions. This paper proposes a sensor-aware interface that uses a Large Language Model (LLM) to answer plain-language questions about stored environmental measurements. The system converts each user question into a structured database query, retrieves the relevant time-series records, and evaluates their quality by identifying missing values, abnormal patterns, and possible sensor drift. It then produces a clear response accompanied by a reliability indication, enabling users to judge how far an answer can be trusted. Performance is evaluated using query-generation accuracy, answer correctness, data-fault detection, and response time, with comparison against a baseline LLM lacking quality checks. The proposed approach aims to make environmental monitoring data more accessible, transparent, and dependable for informed decision-making.

Keywords: Internet of Things, Large Language Models, Environmental Monitoring, Text-to-SQL, Sensor Data Quality.

ICEMSET-2026/FS/577

Smart and Integrated approaches for the management of Bactrocera species in guava

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Abstract

Among fruit crops guava has a major area in tropical and subtropical regions of the Haryana and India. Among insect pests, fruit flies are of serious concern now a day in guava. For managing insect pests in eco-friendly manner integrated approaches has an important role. In this regard, the experiment was conducted at experimental orchard and the results revealed that the minimum fruit infestation (28.33 %) was recorded in treatment having traps + three sprays of neem oil. Next best treatment was traps + three spray of azadirachtin 0.15 % with 29.42 per cent fruit infestation followed by treatments having traps + two sprays of neem oil followed by one spray of agniastra with 31.67 % infestation and all three treatments were found at par with each other. The treatments having trap + three sprays of agniastra and traps + two sprays of agniastra followed by one spray azadirachtin were found least effective among all the treatments with 39.44 and 40.00 per cent fruit infestation. Overall maximum per cent reduction over control was also found higher in the treatments having traps + three sprays of neem oil (49 %), traps + three spray of azadirachtin 0.15 % (47.04%) and traps + two spray of neem oil followed by one spray of agniastra (43.01 %) showed the efficacy of integrated pest management module in pest suppression.

Keywords: *Bactrocera*, Guava, Integrated, Management.

ICEMSET-2026/FS/592

Advanced printing techniques for smart and functional textiles

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Abstract

Varied textile printing techniques are used to apply functional and conductive materials to develop smart and functional textiles. Different conductive inks based on metallic nanomaterials, carbon-based materials and conductive polymers are used. Various surface pre-treatments are used like plasma treatment, chemical surface modification, application of polymeric primers etc. Conductive pathways can be deposited on the surface of the textile material through printing to establish electrical connections between different components. The printed structures can perform different functions such as electrical conduction, sensing, heating and signal transmission. Recent applications in wearable sensors, physiological monitoring electrodes, flexible circuits, heating elements and radio-frequency identification devices are reviewed. Key challenges involving washability, mechanical stability, scalability and environmental sustainability are highlighted. Advanced printing is identified as flexible, lightweight and functional electronic textiles, while emphasizing the need for durable inks and scalable, sustainable manufacturing processes.

Keywords: Advanced textile printing; Conductive inks; Printed electronics; Smart textiles; Wearable electronics.

ICEMSET-2026/FS/596

Reduction in lattice thermal conductivity of CdO due to bond softening via Cobalt doping

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Abstract

Suppressing lattice thermal conductivity is crucial for enhancing thermoelectric efficiency. Through a comparative analysis of pristine and Co-doped CdO, It is observed that Co incorporation significantly reduces the lattice thermal conductivity. The reduced crystallite size (~ 26nm) and enhanced dislocation density (14.9 x 10^{14} /cm^2) in Co-doped CdO promote mass fluctuations and intensify phonon scattering, thereby suppressing heat transport through the lattice. Furthermore, the Raman peaks shift towards lower wavenumber indicating bond softening suggests a reduction in the effective lattice vibrational stiffness. The combined effects of mass fluctuations, enhanced phonon scattering, and bond softening contribute to an approximately 15% reduction in the lattice thermal conductivity of CdO upon Co doping. These findings highlight bond softening, alongside defect-induced phonon scattering, as an effective strategy for suppressing lattice thermal conductivity and potentially enhancing thermoelectric performance.

Keywords: Lattice thermal conductivity, Thermoelectric, Bond Softening, Phonon scattering, Defects.

ICEMSET-2026/FS/598

Phytochemical-Mediated Aphid Resistance in different *Brassica* Crops at Hisar, Haryana

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Abstract

Mustard crop comes under the genus *Brassica* that belongs to the family *Brassicaceae*. Rapeseed and mustard are grown in 53 countries across the globe and are cultivated in India during the *Rabi* season in a variety of agro-climatic conditions ranging from the North-Eastern/North-Western highlands to the low lands, under irrigated/rainfed, timely/late sown and mixed cropping and is widely used as edible oil and cattle feed. Production of rapeseed-mustard (*Brassica* sp.) is severely hampered by aphid infestation in India, specifically *Lipaphis erysimi* (Kalt.). Mustard genotypes DRMRIJ 31, GSL 1, PM 30 and GSC 6 were sown on November 16, 2023 at Research Farm, Oilseeds Section, CCS HAU, Hisar in a plot size of 4.2 m x 3.0 m in three replications in Randomized Block Design (RBD). At the time of initiation of flowering, aphid infestation on one set (T1) of each genotype *i.e.*, DRMRIJ 31, GSL 1, PM 30 and GSC 6 were made free from aphid attack by application of Dimethoate 30EC @ 1ml/litre of water. Second set (T2) were artificially infested by releasing aphid in the plots and simultaneously allowed to get attacked naturally in field. After 48 hours, plant sample were collected (top 10 cm twig of plant) from both infested and uninfested plots and biochemical constituents' analysis were carried out in laboratory. Biochemical constituents were recorded more in plants of different varieties under experimentation that are infested by aphid (T1) as compared to plants that were uninfested (T2) or kept protected (T2) by application of recommended insecticide. In aphid uninfested plants (group T2), biochemical contents *viz.*, mean peroxidase (0.38 µmole/min/mg protein), total glucosinolates (32.3 µmole/g), total phenols (6.2 %), ortho dihydroxy phenols (0.58 mg/g) and flavonols (1.74 mg/g) recorded on lower side (Table 5.6) contrary to plants infested by aphid (group T1) in different varieties as mean persoxidase (0.47 µmole/min/mg protein), total glucosinolates (34.5 µmole/g), total phenols (8.0 %), ortho dihydroxy phenols (0.81 mg/g) and flavonols (2.10 mg/g) have been registered on higher side with the exception of PM 30 cultivar that recorded a decrease of 1.9 per cent in total glucosinolates contents. Overall mean yield obtained in aphid uninfested low (2.4 aphid/10 cm top twig) irrespective of varieties under surveillance was higher (2365.0 kg/ha) as compared to mean yield (1848.8 kg/ha) obtained in infested (139.3 aphid/10 cm top twig). Thus, feeding by

mustard aphid not only triggered the higher production of different biochemical constituents in plants that also reflected in reduction of yield as compared to aphid uninfested one in the experimental field.

Keywords: *Brassica*, mustard, insect-pests, phytochemical, resistance.

ICEMSET-2026/FS/603

Role of Betaine in Natural Deep Eutectic Solvent Development

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Abstract

Several organic molecules from biological systems have been identified as playing a significant role in green chemistry. These molecules are used for stereospecific transformations and for preparing solvents for various applications. Among these molecules, a naturally occurring, stable, zwitterionic, low-molecular-weight compound, betaine, has been associated with various uses. Although its primary use is generally in health treatment or nutraceuticals, its potential in green chemistry is highly relevant. Preparing DES with betaine yields a solvent that can be used for biodiesel purification, enzyme stabilisation, CO_2 capture, electrochemistry, and food packaging film formulation. This paper discusses various methods for synthesising DES using betaine and limitations such as high viscosity, heat sensitivity, and emulsion formation in developing lab-to-industrial-level applications. In conclusion, next-generation betaine-based DES may be combined with a third component or other technology, or integrated with AI-based customisation, to make it a suitable candidate for a sustainable green solvent.

Keywords: betaine, NDES, Green chemistry, Biodiesel.

Industry Persons Oral/Poster Presentations

ICEMSET-2026/IP/169

Interfacial Band-Engineering in Polymer-Ceramic Nanocomposites for High-Efficiency Electrostatic Energy Storage

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Abstract

High-energy-density dielectric capacitors are vital for advanced power electronics, yet their performance is fundamentally constrained by high-field leakage currents and dielectric breakdown. Interfacial band-engineering offers a powerful strategy for advancing polymer–ceramic nanocomposites toward high-efficiency electrostatic energy storage. By tailoring the electronic band alignment at polymer–filler interfaces, charge trapping, carrier mobility, and local field distribution can be precisely controlled. Such engineered interfaces suppress premature breakdown, enhance dielectric permittivity, and minimize conduction losses, enabling higher energy densities without sacrificing reliability. Recent approaches—including surface functionalization, graded interphases, and the incorporation of wide-bandgap nanostructures—create optimized potential barriers that stabilize polarization under high electric fields. This study explores interfacial band engineering as an effective strategy to regulate charge transport and polarization behavior in polymer–ceramic nanocomposites. The proposed band-engineering approach provides valuable insights into interface-controlled dielectric design, offering a scalable pathway for developing next-generation high-performance capacitors for pulsed power systems, electric vehicles, and renewable energy storage applications.

Keywords: Interfacial band-engineering; electrostatic capacitors; energy efficiency; energy storage.

ICEMSET-2026/IP/341

Machine Learning Prediction of Nickel Sulfide-Based Dye-Sensitized Solar Cell and Supercapacitor Performance Using Synthetic Data Augmentation and SHAP Analysis

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Abstract

This study predicts the performance of nickel sulfide (NiS)-based dye-sensitized solar cells (DSSCs) and supercapacitors using machine learning. XGBoost, Gradient Boosting, and CatBoost models were trained to predict power conversion efficiency and specific capacitance from features including electrode composition, dopant concentration, synthesis method, deposition time, annealing temperature, and electrolyte type. On the original dataset, CatBoost achieved the highest test coefficient of determination (R^2) of 0.87. To expand dataset representativeness, synthetic data were generated using CTGAN and Gaussian Copula methods; retraining on the augmented dataset raised the test R^2 to 0.92 with XGBoost. Shapley additive explanations (SHAP) identified annealing temperature, dopant concentration, and deposition time as the most influential parameters, offering guidance for experimental design. These findings show that synthetic data generation combined with interpretable machine learning provides a reliable framework for accelerating the design of NiS-based energy conversion and storage devices.

Keywords: Machine learning; Dye-sensitized solar cells; Supercapacitors; Nickel sulfide; Synthetic data augmentation.

ICEMSET-2026/IP/369

From LLMs to Silicon deep-dive: The Role of Advanced Profiling in Optimizing AI Engines

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Abstract

Large Language Models (LLMs) have become household names, but the core enabler of this AI boom is silicon. Billions of nanoscale circuit elements power these models, provided they are optimally programmed. This presentation maps the journey from raw silicon to functional AI, highlighting the critical role of performance profiling. Specifically, it explores how frameworks like Vitis bridge the hardware-software divide for AI Engines and FPGAs. By leveraging deep run-time mechanisms—such as trace, and profiling—developers can pinpoint device-level execution bottlenecks and memory stalls invisible to traditional software monitors. Key results demonstrate that extracting and analyzing these granular metrics drives profound system-level optimizations, maximizing computational throughput and minimizing latency. Ultimately, hardware-aware co-optimization through deep silicon profiling is the vital link dictating the efficiency and scalability of the hardware powering today's most advanced smart technologies.

Keywords: Artificial Intelligence; Hardware Profiling; Vitis; AI Engine Trace; Silicon-Software Co-design.

ICEMSET-2026/IP/432

SAFER-Agent: A Safety-Aware Agentic AI Framework for Autonomous Satellite Anomaly Diagnosis and Recovery

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Abstract

Modern satellites downlink thousands of housekeeping telemetry channels, yet on-board fault detection, isolation and recovery (FDIR) still relies on static limit checks and pre-scripted safe-mode transitions, while the diagnostic reasoning that converts an alarm into a recovery decision remains on the ground. Agentic artificial intelligence (AI) built on large language models (LLMs) promises to close this gap by reasoning over telemetry, tools and procedures, but its known failure modes, namely hallucination, unsafe tool use and unverifiable plans, conflict with the safety culture of space operations. This paper presents a critical review of the three research streams that must converge for autonomous satellite anomaly management: data-driven telemetry anomaly detection, model-based on-board autonomy and FDIR, and LLM-based agents together with their emerging safety frameworks and runtime assurance (RTA) techniques. Twenty-four primary sources are examined against six capability dimensions (detect, diagnose, recover, assure, adapt and oversee). The review finds that reported detection scores on the Soil Moisture Active Passive (SMAP) and Mars Science Laboratory (MSL) benchmarks are inflated by point-adjusted evaluation, that diagnosis and recovery are rarely evaluated jointly, and that no surveyed agent framework offers machine-checkable safety guarantees. Synthesising these findings, the paper proposes SAFER-Agent, a six-layer safety-aware agentic framework in which an LLM diagnoses with read-only tools, plans from certified playbooks and acts only through a Simplex-style safety governor with tiered autonomy. Four algorithms, ten equations and an evaluation protocol are specified, and open research challenges are identified.

Keywords: Agentic AI, anomaly detection, fault detection isolation and recovery, large language models, runtime assurance, satellite telemetry, spacecraft autonomy.

ICEMSET-2026/IP/481

Energy Materials for Electronic Applications: A Literature Review of Supply-Chain Bottlenecks in Global Critical Minerals

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Abstract

Energy materials are the functional foundation of modern electronic and low-carbon technologies, enabling electrochemical storage, power conversion, sensing, computing, telecommunications and electrified mobility. Their performance depends on highly specified materials such as lithium, nickel, cobalt, graphite and manganese for batteries; neodymium, praseodymium, dysprosium and terbium for permanent magnets; copper

for electrical networks and electronic interconnects; and gallium, germanium, indium, silicon and other high-purity inputs for semiconductor and optoelectronic devices. Yet the rapid expansion of these applications has exposed a structural mismatch between geographically dispersed mineral resources and highly concentrated refining, separation, purification and component-manufacturing capacity. This literature review examines global critical-mineral supply-chain bottlenecks from the perspective of energy materials for electronic applications. It synthesises recent evidence on upstream mining constraints, midstream processing concentration, long project lead times, high capital intensity, reagent and equipment dependencies, environmental permitting, price volatility, trade restrictions, qualification requirements and limited material substitutability. Particular attention is given to rare-earth permanent magnets, where processing concentration and tacit production knowledge create a more binding constraint than geological availability for many light rare earths, and to battery materials, where battery-grade purity, process optimisation and integrated downstream ecosystems determine competitiveness. The review also considers copper and semiconductor-related minor metals, for which grid expansion, co-product dependence and ultra-high-purity specifications generate distinct vulnerabilities. The literature indicates that the economic importance of these minerals is disproportionate to their direct share in final-product cost: small quantities can immobilise high-value manufacturing systems when substitutes are unavailable or redesign and recertification are slow. Policy responses therefore need to extend beyond mining incentives. Effective resilience strategies combine diversified refining capacity, coordinated capital support, long-term offtake, strategic stockpiles, recycling, traceability, design-for-substitution, material-efficiency improvements, workforce development and international cooperation. However, complete self-sufficiency is neither technically realistic nor economically efficient. The strongest evidence supports targeted diversification at the most concentrated processing stages, coupled with circular supply and cross-border coordination. Future research should connect materials science, manufacturing qualification and supply-chain economics more explicitly, especially for electronic-grade materials, secondary recovery and technology-specific substitution thresholds.

Keywords: energy materials; electronic applications; critical minerals; rare earth elements; batteries; semiconductors; supply-chain resilience; industrial policy.

ICEMSET-2026/IP/498

Advanced Correlative Microscopy for Precise Material Characterization and Failure Analysis of Spacecraft Propulsion Components

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Abstract

Failure analysis of spacecraft propulsion system components demands precise identification and characterization of contaminants and inclusions to establish their material composition and assess their potential contribution to component failure. Conventional microscopic evaluation presents significant challenges, particularly when investigating heterogeneous contaminants comprising shiny metallic and matte non-metallic inclusions. Under optical microscopy, metallic inclusions can be readily identified at magnifications of 20–50X using appropriate illumination techniques. However, subsequent material characterization using scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM-EDS) requires accurate retracing to the same regions of interest. Conventional approaches rely on manual mapping and reference markings on sample fixtures, which may become indistinguishable at higher electron-microscope magnifications. Consequently, the process is labor-intensive, time-consuming, and susceptible to inadvertent mapping errors, potentially affecting the reliability and efficiency of failure analysis. To overcome these limitations, an advanced correlative microscopy approach integrating optical microscopy with SEM-EDS has been implemented to enable precise, automated retracing and characterization of regions of interest. The integrated workflow establishes spatial correlation between optical and electron-microscopic images, facilitating systematic investigation of metallic and non-metallic inclusions while minimizing dependence on manual reference marking and operator intervention. This approach leverages the complementary capabilities of optical microscopy for rapid visual identification and SEM-EDS for high-resolution morphological examination and elemental characterization. Implementation of the correlative microscopy system has significantly streamlined the evaluation workflow by reducing manual mapping effort, minimizing the likelihood of traceability mismatch, and improving the consistency and reliability of material characterization. Further automation has enabled seamless image correlation and region navigation, substantially reducing evaluation lead time and supporting timely, failure investigations. The approach also maximizes the effective utilization of the resolution and analytical capabilities of both microscopy techniques. The

implementation demonstrates the value of automated correlative microscopy as an advanced analytical solution for precision material characterization in demanding aerospace applications.

Keywords: Correlative microscopy, advanced microscopy, automated microscopic solutions, precise material characterisation, spacecraft propulsion system applications.

UG/PG/PhD/RA/ Post-doc Student Oral/Poster Presentations

ICEMSET-2026/ST/1001

Tailoring Coating Architecture in Thermally Evaporated SnTe Thin Films for High-Performance Photodetection

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Abstract

Advanced thin-film engineering offers new opportunities to tailor the functional properties of semiconductor coatings for optoelectronic applications. Here, we demonstrate a mask-assisted patterning strategy for fabricating nanostructured tin telluride (SnTe) thin films by thermal evaporation, enabling precise control over coating architecture and photocarrier transport pathways. Stainless-steel slit masks were employed to produce four patterned thin-film configurations (SnTe1–SnTe4) with interconnected nanoflake networks of tunable density, providing an effective route for microstructural engineering. Structural analysis confirms phase-pure cubic SnTe with enhanced crystallinity and reduced lattice imperfections. The engineered coatings exhibit strong visible–near-infrared absorption and superior optoelectronic characteristics. Under 443 nm illumination, the optimized SnTe4 thin film delivers high responsivity, excellent detectivity, and low noise-equivalent power. The enhanced performance originates from pattern-induced photon confinement, increased effective absorption area, and efficient carrier transport. This work establishes mask-directed thin-film patterning as a versatile coating technology for next-generation high-performance optoelectronic devices.

Keywords: SnTe thin films; Thermal evaporation; Patterned thin-film coatings; Light–matter interaction; Optoelectronic devices.

ICEMSET-2026/ST/1002

An All Dielectric Nano-antenna for Highly Directional Quantum Emission

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Abstract

An all-dielectric coupled cavity–antenna is investigated for enhancing and directing emission from solid-state single-photon sources. The structure consists of two TiO_2 cylinders separated by a thin polyvinyl alcohol (PVA) layer containing a nanodiamond colour centre. Multipolar analysis reveals that the PVA layer behaves as an electric-dipole-dominated nanocavity, producing strong electromagnetic confinement and an approximately 30-fold enhancement in the spontaneous-emission decay rate of NV^- centres. The surrounding TiO_2 cylinders function as a dielectric antenna, where interference among the supported multipolar modes controls the far-field radiation pattern. Near the first Kerker condition, corresponding to balanced electric- and magnetic-dipole responses, the vertical collection efficiency approaches 80%. Incorporating a bottom silver reflector further redirects nearly 70% of the emitted power into the upper collection cone. Owing to negligible absorption, the quantum efficiency increases to approximately 0.98 for NV^- centres centre under optimized operating conditions overall.

Keywords: Dielectric cavity-antenna, Titanium dioxide, Nanodiamond, Electromagnetic confinement, Spontaneous -emission.

ICEMSET-2026/ST/1003

First-principles investigation of structural stability, electronic, magnetic, and optical properties of 3d-transition metal substituted Cs_2AgXCl_6 (X: TM) double halide perovskites

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Abstract

In recent years, lead-free double halide perovskites have emerged as promising materials for optoelectronic and spintronic applications, being environmentally friendly and more stable in comparison to lead-based perovskites. In this work, density functional theory (DFT+U) calculations are used in the Cs_2AgXCl_6 double halide perovskite and completely substituted the X lattice sites with 3d transition metal (TM) elements (Sc to Zn) and performed a systematic study of their structural, electronic, optical, and magnetic properties. It is observed from the calculations of the electronic band structure that the substitution of the transition metal significantly modifies the electronic properties. The substitution of Sc, Cr, Co, and Fe shows the bandgap of 3.84 eV, 1.54 eV, 1.19 eV, and 0.46 eV, respectively, while the substitution of other TM elements except Zn shows a half-metallic nature. Further, from the spin-polarized calculations, it is revealed that the introduction of Sc and Zn elements at the X site in Cs_2AgXCl_6 shows non-magnetic behavior. Some compounds show very weak magnetism, like in the case of Ni and Co substitution, some show moderate, while others show strong magnetism, like Cr, Mn, and Fe, with the magnetic moment of 3μB, 4μB, and 5μB, respectively. In addition, the dielectric function, refractive index, and absorption coefficient were also investigated, where substitution of Sc among all TM's shows a large absorption coefficient ($\alpha \sim 10^5$ cm^{-1}) in the high energy range, while Cr substitution shows high absorption in the visible light range, making it suitable for solar cell applications.

Keywords: Lead-free double halide perovskites; Density Functional Theory; Transition metal doping; Optoelectronic materials; Magnetic Properties.

ICEMSET-2026/ST/1004

An Explainable AI-Driven Comparative Framework for Cervical Cancer Detection Using LASSO and Stacked Ensemble Classifier

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Abstract

This paper outlines a comprehensive pipeline for cervical cancer prediction, beginning with the loading of data from two separate files, which were then concatenated. The combined dataset underwent thorough preprocessing, including imputation of missing values with the mean and outlier treatment via IQR capping for numerical features. Categorical features like 'Smokes', 'Hormonal Contraceptives', and various 'STDs' and 'Dx' columns were label encoded to a binary format. To address class imbalance and augment the dataset, CTGAN (Conditional Tabular Generative Adversarial Network) was applied, followed by ADASYN oversampling. Feature engineering was explored and compared using Lasso Regression for feature selection, PCA for dimensionality reduction, and UMAP for non-linear dimensionality reduction, each with consequential effects on different sets of predictive features. Finally, four classification models were used, including the XGBoost Classifier, Logistic Regression (GLM), Gradient Boosting Classifier (GBM), and a Stacked Ensemble Classifier. The Stacked Ensemble model, which utilised Lasso-selected features, demonstrated superior performance across various metrics. Also, to explain the contributions and importance of features, XAI (explainable Artificial Intelligence) approaches such as SHAP (Shapley Additive exPlanations) and LIME (Local Interpretable Model-agnostic Explanations) were implemented.

Keywords: Cervical cancer early detection, LASSO, Stacked Ensemble classifier, XGBoost, Explainable AI, GLM, GBM.

ICEMSET-2026/ST/1005

An Explainable AI Based Machine Learning Framework for Clinical Risk Prediction and Adaptive Disease Dependency Graph Modeling Using Laboratory Reports

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Abstract

Healthcare institutions create a lot of lab reports every day. It is hard to read these reports figure out how sick a patient is found connections between different diseases and make things clear. This project tries to fix these problems. This system addresses these gaps by proposing a unified, end-to-end framework integrating automatic PDF parsing, medical weight normalization, Explainable AI (via SHAP), and graphical probabilistic mapping to establish interpretable clinical graphs. The system is designed to work with lab reports and help doctors understand risk profiles and cross-disease correlations. The project uses Healthcare institutions and lab reports to make this system work.

Keywords: Explainable Artificial Intelligence (XAI), Disease Dependency Graphs, Machine Learning, Clinical Decision Support Systems, Laboratory Report Analysis.

ICEMSET-2026/ST/1006

Smart Iron Monitoring: Development of a Low-Cost Electronic Detector for Pharmaceutical Applications

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Abstract

There is a growing need for simple, low-cost, and real-time tools to monitor the quality of iron tablets, especially in pharmaceutical and field settings. This study develops a compact, cost-effective detector for the quality monitoring of iron tablets. It uses the iron-phenanthroline method with a problem-specific blue-green light-emitting diode (LED) at 510 nm, matching the complex's absorption peak. The system includes a photodiode, an amplifier, a bandpass filter, and an Arduino for signal processing, thereby improving sensitivity and reducing noise. The detector shows excellent linearity over the concentration range of 0.01-10 ppm (R^2 = 0.999) and a low detection limit (0.009 ppm). The maximum relative error in iron estimation is 5%. Treatment with hydroxylamine reduces Fe^{3+} to Fe^{2+}, thereby improving detection and indicating differences in bioavailability. Quality control reveals variations in iron content and oxidation, affecting tablet efficacy. This detector provides a reliable and affordable tool for monitoring the quality of pharmaceutical iron tablets.

Keywords*:* Iron; detector, LED, phenanthroline, spectrophotometry.

ICEMSET-2026/ST/1007

Simulation study of Double Perovskite Solar cell with Multiple Charge Transport Layers

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Abstract

Thallium-based PSCs are currently underexplored for photovoltaic applications. Hallide Double perovskites (HDP) Cs_2TlRhX_6 (X = Cl, Br, I) offer stable, lead free alternative with band gap spanning from 1.29eV–

1.55eV. The PSC structure TCO/ETL/Cs_2TlRhX_6/HTL/Au with seven ETL and seven HTLs are explored using SCAPS-1d. The characteristics properties reveal a clear halide-dependent trend. The Cs_2TlRhI_6 with a bandgap of 1.29 eV shows the highest efficiency of ~24.84% with CdS/Cu_2O as ETL/HTL, followed by $Cs_2TlRhBr_6$ (23.56%) and $Cs_2TlRhCl_6$ (21.79%). The optimal CdS/Cu_2O configuration yields V_{oc} = 1.023 V, J_{sc} = 28.01 mA/cm^2, and FF = 86.69% for Cs_2TlRhI_6, reflecting favorable band alignment and minimized interface recombination with optimal thicknesses for absorber, ETL and HTL are 500 nm, 20 nm and 30 nm respectively. Efficiency remains above 31.72% for defect densities ~10^{15} cm^{-3}, indicating moderate defect tolerance. These results establish Cs_2TlRhX_6 with CdS/Cu_2O as a promising lead-free PSC exceeding 24% efficiency. The study also shows impact of absorber, ETL and HTL thickness along with defect density on PSC performance parameters.

Keywords: Double perovskite, SCAPS-1D, ETL, HTL, charge transport layer.

ICEMSET-2026/ST/1008

Environment toxicant and cancer development

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Abstract

Environmental toxicants are increasingly recognized as major contributors to the global burden of cancer in both humans and animals. These toxicants originate from industrial activities, agricultural practices, urbanization, and environmental pollution, leading to widespread contamination of air, water, soil, and food chains. Animals, particularly wildlife species, often serve as sensitive indicators of environmental contamination because they are continuously exposed to pollutants in their natural habitats. Comparative zoological studies have revealed striking similarities between cancer development in animals and humans, suggesting that many carcinogenic mechanisms are conserved across species. The present study examines the role of environmental toxicants in cancer development through a comparative zoological perspective. It evaluates major classes of environmental toxicants, including heavy metals, pesticides, industrial chemicals, and radiation, and their impact on carcinogenesis in various animal species

ICEMSET-2026/ST/1009

GWO-Based Adaptive PID Control for Frequency Stabilization in Renewable-Integrated Multi-Area Power Networks

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Abstract

Renewable energy sources are increasingly being used in modern integrated power systems. Large variations in the system's inertia result from this. Additionally, it causes sporadic disruptions in frequency. For load frequency control (LFC), these interruptions are a significant issue. The design and analysis of an adaptive proportional-integral-derivative (PID) controller are presented in this paper. The grey wolf optimizer (GWO) algorithm serves as the foundation for the controller. The goal is to give a three-area power system frequency stability. Photovoltaic (PV), wind, and thermal generators make up the network. The PID gain parameters are suitably adjusted using the metaheuristic GWO approach. The Integral of Time-weighted Absolute Error (ITAE) is reduced as a result. The researchers used MATLAB/Simulink to assess the design. The GWO tuned PID controller performs better than the other controllers, according to the results. It is superior to the traditional GA-based and PSO-based PID controllers. It provides improved steady state frequency inaccuracy, peak overshoot, and settling time. In eight to ten seconds, the suggested framework settles. Additionally, it limits the overrun to less than 5%. This illustrates its robustness and practicality for contemporary smart grid scenarios.

Keywords: LFC, Automatic Generation Control (AGC), Grey Wolf Optimizer technic (GWO), PID Controller, Renewable Energy, Multi-Area Power Systems, ITAE, Frequency Regulation.

ICEMSET-2026/ST/1010

Colliding- and Single-Plasma Pulsed Laser Deposition of Cu-MoO_x Alloy Thin Films: A Comparative Structural and Optical Study

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Abstract

Cu-MoO_x alloy films are deposited on a glass substrate via pulsed laser deposition using a colliding-plasma configuration at 40 mJ laser energy and $\approx 10^{-5}$ mbar ambient air pressure. The study investigates the influence of deposition time and compares it with the solid-state mixed (single-plasma) film in terms of structural and optical properties. Deposition durations of 30, 45 and 60 minutes are examined using X-ray Diffraction (XRD) and UV-visible spectroscopy. The 45-minute-deposited film, after annealing, indicates improved crystallinity and an optimal optical bandgap (3.4637 eV), whereas further deposition to 60 minutes alters the film characteristics. The optimised film is later compared with the single-plasma film using XRD and scanning electron microscopy, revealing better crystallinity and a more uniform, homogeneous morphology. The study establishes that at selected ambient air pressure, laser energy, and deposition time, the colliding plasma approach is more effective in improving the quality of the Cu-MoO_x alloy film.

Keywords: Cu-MoO_x alloy films; Pulsed laser deposition; Colliding-plasma; Plasma-mixed alloy.

ICEMSET-2026/ST/1011

Effect of oxygen partial pressure on SnO_2 thin films prepared by magnetron sputtering for CO Gas sensing

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Abstract

Gas sensors are essential for monitoring and controlling air pollution. Among various metal oxides, SnO_2 is one of the most promising materials for gas-sensing applications. As oxygen vacancies play an important role in gas sensing, we have prepared SnO_2 thin films by sputtering at different oxygen flow rates, while keeping the other process parameters fixed. The structural and optical properties confirm the influence of oxygen partial pressure on SnO_2 thin films. A polycrystalline nature with tetragonal rutile structure was determined by GIXRD, and the bandgap changed from 3.55 to 3.88 eV. The gas-sensing performance of the optimized SnO_2 sample showed high selectivity towards CO. The sensor response was increased from 52.67% to 93.15% over the 200-400 ^oC temperature range. While the response/recovery times vary from 48 s to 6 s, and 117 s to 37 s. Thus, oxygen partial pressure strongly influences the CO gas sensing of SnO_2 thin films.

Keywords: SnO_2 thin film, Magnetron sputtering, O_2 partial pressure, CO gas sensor.

ICEMSET-2026/ST/1012

Achieving Operational Resilience in Air Quality Monitoring: An IoT Solution with Multi-Platform Data Access

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Abstract

Conventional air-quality monitoring systems, are expensive and typically have limited spatial coverage, which limits urban air-quality monitoring. This work aims to present a low cost portable IoT-based environmental

monitoring system based on Arduino R4 Wi-Fi, DHT22 sensor for temperature, relative humidity and MQ135 sensor for measurement of the gaseous pollution level in real-time. System offers real-time data visualization via OLED display, web interface and ThingSpeak cloud platform, which means that it can be accessed both from the on-site location and remotely. Power-efficient operation is realized by adaptive sleep modes, achieving almost 15 hours of operation with a 2000 mAh battery. It features auto network reconnection function for smooth operation in case of temporary network disconnections. System proposed can be used to provide a scalable and economic solution for real-time environmental monitoring, and identify local changes that may not be captured by the few monitoring stations that are currently available.

Keywords: IoT-based air quality monitoring; Arduino R4 Wi-Fi; Multi-platform data visualization; Real-time environmental assessment; Scalable air quality monitoring system.

ICEMSET-2026/ST/1013

Smart Crop Protection from Wildlife Intrusion Using Embedded Systems and Eco-Friendly Deterrent Mechanism

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Abstract

Wildlife intrusion into agricultural fields causes significant crop losses and economic hardship, particularly in regions bordering forests. Conventional protection methods, including manual surveillance, barbed-wire fencing, and scare devices, are often labor-intensive, costly, and ineffective over time. This paper presents an Integrated Crop Protection System based on a Raspberry Pi 4 for real-time, autonomous farm security. The system combines an HC-SR04 ultrasonic sensor for intrusion detection, a flame sensor for fire monitoring, a USB camera for image capture, and an SD card for event logging. Upon detecting an intrusion, the system activates a piezoelectric buzzer, an automated water pump, and a controlled electric fence as non-lethal deterrents. Experimental evaluation achieved a 96% intrusion detection accuracy, with buzzer activation within 0.1 s and water pump response within 1.8 s. The proposed solution is cost-effective, scalable, environmentally friendly, internet-independent, and suitable for enhancing crop protection while supporting sustainable agricultural practices.

Keywords: Wildlife intrusion detection; Crop protection; Raspberry Pi; Ultrasonic sensor; Non-lethal deterrence.

ICEMSET-2026/ST/1014

Multifunctional surface engineering of 316L stainless steel implants: corrosion optimisation, osteointegration and local antibiotic delivery

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Abstract

Orthopaedic implants are susceptibility to body-fluid corrosion and postoperative infection, promoting surface protection. This study developed a duplex coating approach combined HAp/TCP bioceramic with a gentamicin-loaded, glutaraldehyde-crosslinked chitosan coating. Surface treatment for 304L, 316L and Ti6Al4V were optimised through Taguchi design and evaluated by potentiodynamic polarisation, EIS, SEM, in vivo rabbit implantation, push-out testing, drug release, cytotoxicity and antimicrobial assays. Optimised 316L had the lowest i_{corr}, decreasing from 0.1231 to 0.0001938 A (99.84%), with E_{corr} shifting from -0.2205 to -0.00139 V. At 90 days, new-bone formation for coated implants was 30.60% and push-out strength was 16.67 MPa. The porous HAp-rich nanostructure coating promoted osteointegration, whereas crosslinked chitosan controlled the

gentamicin release and microbial-growth. Maximum release was within 15-20 days and polymer integrity was maintained for 90 days. The novelty is the integration of corrosion optimization, osteogenic bioceramics and antibiotic delivery, which paves a promising route for durable, infection-resistant orthopaedic implants.

Keywords: 316L Stainless Steel, HAp/TCP bioceramic coating, Orthopaedic implant corrosion, Cytotoxicity assays, Antimicrobial assays.

ICEMSET-2026/ST/1015

Structural and Magnetic Properties of Altermagnetic CrSb Single Crystal

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Abstract

Altermagnets are collinear antiferromagnets with alternating local structures around opposite-spin sublattices that enable a spin-split Fermi surface without net magnetization, giving rise to spin-dependent phenomena absent in typical antiferromagnets. Among altermagnetic candidates, CrSb exhibits g-type altermagnetism with a multi-pocket Fermi surface. Here, we synthesize a single crystal of CrSb and present a detailed characterization of its magnetization, electrical transport, and magnetotransport properties in conjunction with first-principles calculations. CrSb shows metallic behavior with a spin-split Fermi surface in the antiferromagnetic state with an ordering temperature T_N ~ 707 K. It exhibits a large nonsaturating magnetoresistance with sixfold symmetry at low temperature in accord with the crystal structure and Fermi surface. These results suggest that CrSb is a unique altermagnetic system with high carrier mobilities and anomalous transport properties, promising for applications.

Keywords: Altermagnets, collinear antiferromagnets, magnetization, spin-split Fermi surface.

ICEMSET-2026/ST/1016

Plasma-Tuned Surface Electronic States and Defect Chemistry of Ni-Phyllosilicate for Emerging Hydrogen-Evolution Technologies

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Abstract

Non-thermal dielectric barrier discharge plasma was utilized to modify the surface electronic states, defect chemistry, and interfacial activity of Ni-phyllosilicate clay for hydrogen production. By systematically varying plasma exposure time and reactive atmosphere, the resulting materials were analyzed with XRD, FTIR, BET, HRTEM, CHNS, XPS, and electrochemical tests. Plasma treatment enhanced local NiO/NiO_x ordering, surface functionalization, defect formation, and dynamic Ni redox processes, all while maintaining the phyllosilicate structure. The specific surface area rose from 7.74 to 30.09 m^2/g. XPS indicated transient Ni(III) species after brief air-plasma exposure, then stabilized hydroxylated Ni(II)-rich surface states. The 2-minute air-plasma sample showed the best hydrogen-evolution performance, with about 302 mV overpotential at 10 mA/cm^2 and a Tafel slope around 22 mV/dec. These results highlight plasma's ability to control surface states for advanced electrochemical energy applications.

Keywords: Electronic materials; Plasma surface engineering; Ni-phyllosilicate; Defect chemistry; Hydrogen evolution.

ICEMSET-2026/ST/1017

Performance Optimization of an Asymmetric Quantum Otto Cycle Using Omega Criterion and Reservoir Squeezing

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Abstract

We investigate the thermodynamic performance of an asymmetric quantum Otto cycle employing a one-dimensional time-dependent harmonic oscillator as the working medium. We introduce asymmetry in the cycle through unequal driving speeds during the two work strokes, resulting in two distinct configurations: sudden compression and sudden expansion. Using the Omega criterion, we compute the optimal efficiency and coefficient of performance for the engine and refrigerator, respectively. Our results show that the cycle performance is consistently higher for the sudden compression configuration than for the sudden expansion configuration. We further examine the effect of reservoir squeezing and demonstrate that it monotonically enhances the optimal performance of both operating modes. These results highlight the combined role of work-stroke asymmetry and reservoir squeezing in enhancing the performance of quantum Otto thermal machines.

Keywords: Quantum Otto cycle; harmonic oscillator; asymmetry; squeezing; optimization.

ICEMSET-2026/ST/1018

Comparative Analysis of Adaptive Wavelet and Traditional Preprocessing Methods for Plant Leaf Images

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Abstract

Preprocessing is a critical stage in plant disease detection because the quality of the input image significantly influences the effectiveness of subsequent image analysis. In this study, three image preprocessing techniques are systematically evaluated: median filtering, histogram equalization, and a hybrid approach combining median filtering with an adaptive wavelet transform. These techniques are compared for their ability to suppress common degradations in plant leaf images, such as White Gaussian noise, salt-and-pepper noise, impulsive noise and compression artifacts. Their performance is quantitatively assessed through numerical simulation of Mean Square Error (MSE) and Peak Signal-to-Noise Ratio (PSNR). The results illustrate that median filtering effectively reduces impulsive noise but may blur fine structural details. Histogram equalization improves image contrast; however, it can also amplify residual noise. In comparison, the hybrid method based on median filtering and adaptive wavelet transform with BayesShrink provides the best denoising performance while preserving important leaf features. It achieves the lowest MSE of $4.71051\times10-5$ and the highest PSNR of 43.269 dB, demonstrating that the adaptive wavelet-based approach is more effective than the traditional preprocessing methods for enhancing plant leaf images.

Keywords: Plant leaf image preprocessing, Adaptive wavelet transform, Median filtering; Histogram equalization, Image denoising.

ICEMSET-2026/ST/1019

Photopyroelectric Investigation of Concentration-Dependent Thermal Diffusivity in PVDF Films

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Abstract

Polyvinylidenefluoride (PVDF), having excellent phase-dependent functional properties is widely explored for photonic applications. The work demonstrates the fabrication of PVDF films with its concentrations ranging

from 0.1 to 0.5 g by solution-casting method. Phase and structural evolution of films are investigated by Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), and scanning electron microscopy (SEM). Thermal transport properties are evaluated using the back photopyroelectric (BPPE) technique to understand the concentration-dependent thermal diffusivity. FTIR revealed enhanced β/γ-phase formation at intermediate concentrations, while XRD confirmed the transformation of pristine α-phase into β-phase-rich films. BPPE study shows improved thermal diffusivity from 1.53×10^{-7} to 5.18×10^{-7} $m^2 s^{-1}$ at intermediate concentrations, attributed to enhanced molecular chain alignment. At higher concentrations, SEM revealed agglomeration, increases phonon scattering thereby decreasing thermal diffusivity. These concentration-dependent thermal properties of PVDF highlights the potential of PVDF for thermal management systems, flexible devices, and sensors.

Keywords: PVDF, Photopyroelectric, Thermal diffusivity.

ICEMSET-2026/ST/1020

Thermal Diffusivity Tuning in ZnO Nanoparticles through Indium Oxide Incorporation: A Photoacoustic Spectroscopy Approach

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Abstract

The growing demand for thermoelectric materials and advanced thermal management systems increases the necessity for nanomaterials with tunable thermal transport properties. Zinc oxide (ZnO) is an emerging oxide semiconductor whose thermophysical behaviour can be effectively tailored through compositional modification. In this work, ZnO nanoparticles with varying indium oxide (In_2O_3) content are synthesised by the solution combustion method to investigate the relationship between structural characteristics and thermal diffusivity. Thermal diffusivity is measured using laser-induced photoacoustic spectroscopy and found to decrease with increasing In_2O_3 content, reaching a maximum reduction of 34.84% in the InZnO3 (ZnO with 0.05 g In_2O_3) sample. X-ray diffraction pattern confirms the retention of the hexagonal wurtzite ZnO structure with increased lattice distortion. The InZnO3 sample exhibits the highest dislocation density (2.898×10^{-3} nm^{-1}) and microstrain (4.629×10^{-3}), and the lowest thermal diffusivity (13.564×10^{-3} $cm^2 s^{-1}$), demonstrating effective phonon-transport tuning for thermoelectric applications.

Keywords: Zinc oxide; Indium oxide; Photoacoustics; Thermal diffusivity; Dislocation density.

ICEMSET-2026/ST/1021

Investigation of Au/V_2O_5/undoped-InP MIS-type Photodiode Properties Under Different Illumination Intensities

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Abstract

The electrical and photodiode properties of the Au/V_2O_5/undoped-InP metal/interlayer/ semiconductor (MIS)-type photodiode were systematically investigated using current–voltage (I–V) measurements under illumination intensities ranging from 20 to 100 mW/cm^2. The influence of light intensity on key photodiode parameters, including responsivity, specific detectivity and the relationship between photocurrent and incident light intensity, was examined. In addition, the barrier height (Φ_b), ideality factor (n), series resistance and shunt resistance were evaluated under both dark and illuminated conditions. As the illumination intensity increased from dark to 100 mW/cm^2, the n increased from 1.14 to 1.37, while the Φ_b decreased from 0.55 to 0.47 eV, indicating enhanced carrier generation and interface-related transport under illumination conditions. Furthermore, the interface state density exhibited a clear dependence on illumination intensity, reflecting the influence of light on interface trap states. These findings demonstrate the effectiveness of V_2O_5 interlayers in enhancing InP-based MIS photodiode performance for optoelectronics applications.

Keywords: Indium phosphide; Vanadium pentoxide; MIS-type photodiode; Electrical and photodiode properties; Density of states.

ICEMSET-2026/ST/1022

Structural, Electrical and Current Conduction Mechanism of Au/Cr_2O_3/undoped-InP MIS-type Schottky Diode

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Abstract

The electrical characteristics of Au/Cr_2O_3/un-InP metal/interlayer/semiconductor (MIS)-type Schottky diode were evaluated using current-voltage (I-V) and capacitance-voltage (C-V) measurements. The structural and optical properties were examined using FTIR, Raman and UV-Vis spectroscopy techniques, confirming the growth of stoichiometric, nanocrystalline Cr_2O_3 with a hexagonal phase on InP. The observed optical band gap of Cr_2O_3 was ≈3.5 eV at room temperature. The incorporation of a Cr_2O_3 layer between metal and semiconductor significantly enhanced the barrier height (Φ_b), yielding (0.64 eV (I-V)/0.86 eV (C-V)) for the MIS diode compared to the Au/undoped-InP Schottky diode (SD) (0.57 eV (I-V)/0.67 eV (C-V)), indicating improved diode performance. In the reverse-bias region, the current conduction mechanism is governed by Schottky emission (SE) at higher bias regions, while Poole-Frenkel emission (PFE) dominates in the lower-bias region for both SD and MIS diodes. This study reveals that the Cr_2O_3 layer significantly improves device performance, advancing electrical components for next-generation electronics and energy applications.

Keywords: Structural properties; electrical characteristics; current conduction mechanism, chromium oxide; undoped-InP.

ICEMSET-2026/ST/1023

Emerging Solar Cell Materials: Advancing Sustainability and Decarbonization

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Abstract

Increasing worldwide energy demand and escalating greenhouse gas emission have propelled the need of high-performance and sustainable renewable energy technologies. Among several renewable energy sources, the solar photovoltaics (PV) has appeared as a most promising solutions, with perovskite solar cells and organic solar cell showcasing the substantial breakthroughs in emerging solar cell materials over a decade. With remarkable power conversion efficiency, flexible structure these solar cell materials are positioning them as strong contenders for future solar photovoltaic energy applications. Perovskite solar cells have achieved power conversion efficiencies of approximately 27.3% driven by properties like tunable bandgaps ad strong light absorption. Likewise, organic solar cells have achieved the power conversion efficiencies of approximately 19.4% by incorporating non-fullerene acceptor (NFA) materials offering flexibility and compatibility for innovative application such as building-integrated photovoltaics (BIPV). Apart from this, both these solar PV technologies exhibit relatively lower carbon footprints and energy payback times directly contributing to CO_2 reduction goals. The energy payback time (EPBT) is of 0.35 years and greenhouse gas emission factor is 10.7 g CO_2-eq/kWh for the all-perovskite tandem design compared to 1.52 years and 24.6 g CO_2-eq/kWh for the silicon benchmark. For organic PVs the energy payback time is nearly 0.14–1.11 years with few research works claiming the energy payback time even less than 100 days for OPV and GHG emission factor to be around 37.77 g CO_2-eq /kWh at 3% efficiency. This review summarises current status, key challenges, commercial prospects for perovskite and organic solar cells, identifying their critical role in achieving a sustainable, low-carbon energy future.

Keywords: Solar cell materials, Perovskite Photovoltaic, Organic Photovoltaic, Sustainability, Emerging Technologies.

ICEMSET-2026/ST/1024

Recent Advances in Coverless Image Steganography: A Review

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Abstract
In conventional image steganography, secret information is embedded in spatial-domain by changing pixels or frequency-domain by manipulating coefficients of image. Such changes, though feasible up to payload capacity, but introduce statistical traces that are susceptible to steganalysis. Coverless image steganography (CIS) technique does not require direct alteration of carrier images by employing natural characteristics of images or creating images related to secret information, to enhance steganalysis resistance. This review focuses on latest CIS approaches for generation-based and mapping-based CIS. The generation of images using Generative Adversarial Network (GAN) has resolved the need of database of carrier images, but it does have concerns regarding payload, robustness, and computational cost. In mapping-based techniques, secret-to-image correspondences are made based on intrinsic features of image, including image hashes, average pixel statistics, Histogram of Oriented Gradients (HOG), Scale-Invariant Feature Transform (SIFT) and learned features. Recently, methods though more robust and stable in features, but there are still issues of embedding capacity, and computational efficiency.

Keywords: Coverless image steganography; Generation-based steganography; Mapping-based steganography; Feature mapping; Generative models; Steganalysis.

ICEMSET-2026/ST/1025

K-Band Microstrip Patch Antenna with Low Return Loss for Short Range Communication

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Abstract
This paper deals with the design of a microstrip patch antenna which operates in the K-band frequency. The proposed antenna has an overall dimension of 80 × 80 mm². The return loss is −51.35 dB at a resonant frequency of 20.483 GHz. The VSWR is close to unity. Efficiency is good at 90.5%. It has a gain of 11.68 dBi. It can be used for short range applications like traffic radar.

Keywords: Patch antenna, Return Loss, VSWR, Efficiency.

ICEMSET-2026/ST/1026

Rational Design of $CoFe_2O_4$//CdSe Asymmetric Supercapacitors: From Individual Electrode Evaluation to High-Voltage Energy Storage

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Abstract
The development of high-energy-density electrochemical energy storage devices requires the rational design of complementary electrode materials with suitable electrochemical characteristics. The synthesized materials were

characterized using X-ray diffraction (XRD), Fourier-transform infrared (FTIR) spectroscopy, UV–visible spectroscopy, scanning electron microscopy (SEM), and energy-dispersive X-ray analysis (EDAX) to determine their crystal structure, functional groups, optical band gap, morphology, and elemental composition. The electrodes were fabricated on nickel foam and initially evaluated individually in a three-electrode configuration using 1 M KOH electrolyte through cyclic voltammetry (CV), galvanostatic charge–discharge (GCD), electrochemical impedance spectroscopy (EIS), and cycling stability measurements. Open-circuit potential (OCP) analysis confirmed the complementary electrochemical behavior of CdSe and $CoFe_2O_4$ as negative and positive electrodes, respectively. The assembled two-electrode device was investigated using suitable electrolyte solution. The results demonstrate that the rational pairing of electrodes is a promising strategy for developing high-voltage asymmetric supercapacitors with potential applications in next-generation energy storage.

Keywords: Electrode materials; $CoFe_2O_4$; CdSe; Three and two electrode systems; Asymmetric supercapacitor.

ICEMSET-2026/ST/1027

A Ni (II) based Fluorescent Coordination Architecture for Selective Sensing of Trinitrophenol (TNP) in an Aqueous Medium

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Abstract

A Ni (II)-based fluorescent coordination compound was successfully synthesised using a multifunctional ligand 2-(4-carboxyphenyl)-1H-benzo[*d*] imidazole-6-carboxylic acid (L) under solvothermal conditions and characterised using several analytical techniques such as elemental analysis, FTIR spectroscopy, thermogravimetric analysis, and powder X-ray diffraction studies. The as-synthesised compound exhibits excellent fluorescent emission in water, attributed to ligand–centred π-π* transitions modulated by metal coordination. Interestingly, this compound demonstrates highly selective and sensitive fluorescence quenching of Trinitrophenol (TNP) among various nitroaromatic explosives, including 4-NT, 2-NT, 2-NP, 3-NP, 4-NP, 1,3-DNB, and 2,4-DNP. A remarkable detection limit of 0.183 ppm was obtained, indicating excellent sensing performance. Density functional theory (DFT) calculations reveal that the sensing mechanism is predominantly ligand-centered and driven by a photo-induced electron transfer (PET) process. The strong electron-accepting character of TNP, together with H-bonding interactions between TNP and 1, promotes efficient electron transfer from the excited ligand to TNP, resulting in significant fluorescence quenching. It also showed rapid response and good stability in aqueous medium, highlighting its potential as an efficient fluorescent probe for trace-level detection of TNP in water.

ICEMSET-2026/ST/1028

Sustainable Synthesis of Nitrogen-Doped Carbon Quantum Dots from Zanthoxylum armatum for Environmental Lead Monitoring

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Abstract

Nitrogen-doped carbon quantum dots (N-CQDs) were synthesized through an eco-friendly and sustainable route using leaves of *Zanthoxylum armatum* as the precursor material. The synthesized N-CQDs exhibited promising optical properties and were evaluated for their ability to detect Pb^{2+} ions selectively and sensitively in water samples. A comprehensive set of analytical techniques was employed to characterize the structural, morphological, and optical features of the prepared N-CQDs, including UV-Visible spectroscopy, fluorescence spectrophotometry, Fourier-transform infrared (FTIR) spectroscopy, powder X-ray diffraction (PXRD), scanning electron microscopy (SEM), and X-ray photoelectron spectroscopy (XPS). Upon interaction with Pb^{2+}

ions, a pronounced quenching of the fluorescence signal was observed, confirming the potential of these N-CQDs as effective nanosensors for heavy metal ion detection, achieving a limit of detection as low as 1.66 µM. The exclusive use of plant-based raw material along with a green synthesis protocol underlines the environmentally responsible nature of this research.

Keywords: Nitrogen-doped carbon quantum dots (N-CQDs); *Zanthoxylum armatum*; green synthesis; fluorescence sensing; lead (Pb^{2+}) detection; Static quenching; photoluminescence; environmental monitoring.

ICEMSET-2026/ST/1029

Enhanced Photocatalytic degradation of organic colorants by green biosynthesized sunlight-active sugarcane bagasse biochar loaded with SnS_2 nanocomposite

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Abstract

The persistence of synthetic dyes demands sustainable photocatalysts for wastewater treatment. Herein, a sunlight-active BC@SnS_2 nanocomposite was green-synthesized by anchoring SnS_2 nanoparticles onto sugarcane bagasse-derived biochar using *Azadirachta indica* leaf extract. Characterization confirmed successful composite formation with enhanced surface area, a reduced band gap (2.03 eV), improved sunlight absorption, and suppressed charge-carrier recombination. Under optimized conditions (20 mg catalyst, pH 5), the BC@SnS_2 composite achieved 94.6% degradation of Malachite Green (3 mg L^{-1}) and 93.1% degradation of Rhodamine B (2 mg L^{-1}) within 120 min under natural sunlight. Adsorption followed the Langmuir isotherm, while degradation obeyed pseudo-first-order kinetics. Scavenger experiments identified $^{\bullet}OH$ as the dominant reactive species, with $^{\bullet}O_2^-$ and h^+ also contributing. LC–MS analysis confirmed the formation of less harmful degradation products. The photocatalyst retained over 85% activity after six reuse cycles and exhibited excellent performance in representative water matrices. The waste-derived, bio-assisted BC@SnS_2 nanocomposite demonstrates strong potential as a sustainable photocatalyst for efficient sunlight-driven dye remediation.

Keywords: BC@SnS_2 nanocomposite, Natural sunlight-driven photocatalysis, Bio-assisted synthesis, Malachite Green, Rhodamine B, LC-MS degradation pathway.

ICEMSET-2026/ST/1030

Green synthesis of MoS_2 nanoflowers using leaf extract of Psidium guajava and Carica papaya for biomedical applications

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Abstract

Molybdenum disulfide (MoS_2) the most prominent member of the transition metal dichalcogenide (TMD) family, has redefined expectations in 2D materials research due to its layer-dependent electronic bandgap and exceptional surface-to-volume ratio. While traditional synthesis methods often utilize hazardous organic solvents and energy-intensive conditions, the shift towards green hydrothermal synthesis offers a sustainable alternative. By utilizing biomolecular precursors and aqueous reaction media, we can achieve high-purity nanostructures that exhibit superior performance in energy storage, and biomedical applications. This work elaborates on the synthesis kinetics, characterization, and the synergistic effects observed in hydrothermally green synthesized MoS_2 nanoflowers using Psidium guajava and Carica papaya leaf extract. The synthesized MoS_2 were characterized using various analytical techniques including X-ray diffractometry (XRD), Field emission scanning electron microscopy (FE-SEM), Scanning Electron Microscopy (SEM), Energy

dispersive X-ray (EDX), UV-Vis and Raman spectroscopy. The antibacterial activities against Gram-positive and Gram-negative were investigated by well diffusion method.

Keywords: 2D materials, Transition metal dichalcogenides, hydrothermal synthesis, nanoflowers, well-diffusion method.

ICEMSET-2026/ST/1031

Covalent Organic Frameworks as Emerging Photocatalysts and Electrocatalysts for Renewable Energy Conversion

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Abstract

Covalent organic frameworks (COFs) have emerged as efficient photo- and electrocatalysts owing to their ordered structures, high porosity, tunable electronic structures, and modular functionality. Recent developments have revealed the immense potential of COF-based catalysts in renewable energy generation processes, particularly in the oxygen evolution reaction (OER), oxygen reduction reaction (ORR), hydrogen evolution reaction (HER), and carbon dioxide reduction reaction (CO_2RR). Several strategies, including heteroatom doping, metalation, engineering of donor–acceptor units, and hybridization with conductive materials, have demonstrated substantial enhancement in the catalytic efficiency of COFs. This review presents a comprehensive overview of the latest strategies employed to improve the catalytic performance of COFs. The fundamentals of electrocatalysis and photocatalysis involved in the energy generation and conversion processes are also discussed. Synthetic methods and structural features of COFs critically influence their catalytic efficiency. Therefore, various synthetic approaches and characterization techniques for COFs are also described. In addition, existing challenges in the practical use of COF-based catalysts and the future perspectives for the continued development of robust and efficient COF-derived photo- and electrocatalysts for sustainable and scalable energy technologies are discussed.

Keywords: COF; HER; OER; ORR; CO_2RR; Electrocatalysis; Photocatalysis.

ICEMSET-2026/ST/1032

Modification of Biomedical Polymer Surface Wettability with FE-DBD Plasma

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Abstract

Atmospheric-pressure plasmas, particularly Floating Electrode Dielectric Barrier Discharge (FE-DBD), have attracted considerable interest for surface modification due to their low cost, simplicity, and effectiveness in biomedical and materials applications. In this study, a cost-effective FE-DBD device was developed to treat polymeric and biological surfaces. The effects of treatment time and discharge distance on surface wettability of polymer films used in welded blood bags were evaluated by water contact angle measurements. The FE-DBD treatment significantly altered the contact angle, indicating a changement in the polymer's wettability resulting from plasma-induced chemical functionalization and possible surface morphology changes. These results demonstrate the potential of FE-DBD for modfying the surface energy and adhesion of polymer and other biomedical polymers through controlled surface modification.

Keywords: Atmospheric Cold Plasma, Floating Electrode Dielectric Barrier Discharge, Plasma Parameters Effects, Polymer, Wettability.

ICEMSET-2026/ST/1034

Green synthesis of MoS_2 nanoflowers using leaf extract of Psidium guajava and Carica papaya for biomedical applications

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Abstract

Molybdenum disulfide (MoS_2) the most prominent member of the transition metal dichalcogenide (TMD) family, has redefined expectations in 2D materials research due to its layer-dependent electronic bandgap and exceptional surface-to-volume ratio. While traditional synthesis methods often utilize hazardous organic solvents and energy-intensive conditions, the shift towards green hydrothermal synthesis offers a sustainable alternative. By utilizing biomolecular precursors and aqueous reaction media, we can achieve high-purity nanostructures that exhibit superior performance in energy storage, and biomedical applications. This work elaborates on the synthesis kinetics, characterization, and the synergistic effects observed in hydrothermally green synthesized MoS_2 nanoflowers using Psidium guajava and Carica papaya leaf extract. The synthesized MoS_2 were characterized using various analytical techniques including X-ray diffractometry (XRD), Field emission scanning electron microscopy (FE-SEM), Scanning Electron Microscopy (SEM), Energy dispersive X-ray (EDX), UV-Vis and Raman spectroscopy. The antibacterial activities against Gram-positive and Gram-negative were investigated by well diffusion method.

Keywords: 2D materials, Transition metal dichalcogenides, hydrothermal synthesis, nanoflowers, well-diffusion method.

ICEMSET-2026/ST/1035

Thermal Cooling Enhancement of Computer Processor with Custom Liquid Cooling Module

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Abstract

The thermal cooling enhancement technique employing an upgraded custom liquid cooling system on a mid-level computer processor is studied experimentally. The monitored parameters primarily focus on the CPU operating at continuous 100% maximum utilization, while maintaining overall power consumption of the cooling system within controlled limits. It has been found that the custom cooling module performs significantly better when compared against an air-cooling module consuming similar power. The custom system achieved an average sustained temperature of 57.4°C versus 69.2°C for air cooling an improvement of 11.8°C on average and up to 14°C at peak under full throttle load conditions. The cooling module achieved this performance while being fabricated at approximately 30% of the cost of comparable commercially available liquid cooling systems.

Keywords: Thermal cooling; CPU; CPU cooling; Processor; custom cooling; temperature.

ICEMSET-2026/ST/1036

Nickel Based Polymer Composites for EMI Shielding in the X-band region

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Abstract

In the current era of growing digitalization, there is a proportional escalation in the usage of electronic gadgets and wireless technology. This has resulted in electromagnetic pollution – a serious threat to sensitive electronic

equipment and environment. Addressing this challenge is imperative by implementing the usage of efficient electromagnetic shields. This paper aims at engineering Nickel particles in the versatile Polyvinyl acetate (Fevicol) matrix to develop electromagnetic shields for microwaves in the X-band region (8.2GHz-12.4GHz). The main characteristic feature of an EMI shielding material is the property of magnetism and conducting. Thus, Nickel being a bi-functional element, is a highly suitable candidate. Apart from the magnetic and conducting characteristics, a material bearing dielectric properties and flexibility is sought after for electromagnetic interference (EMI) shielding applications. Due to the ready availability and applicability of fevicol on various substrates, a synergistic blend of milled Ni particles and Fevicol is prepared at various proportions. The samples were fabricated as flexible films and systematically investigated. The Ni-fevicol films showed a total shielding of ~30dB, blocking 99% of the incoming radiation, proving their efficacy as good shielding materials.

Keywords: EMI Shielding, Nickel, Polymer, Composite, X-band.

ICEMSET-2026/ST/1037

Electrical Characterization of a Parallel Multi-Gate Junctionless FET with HfO_2 Gate Dielectric: A TCAD Simulation Study

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Abstract

Continued scaling of conventional transistors is limited by short-channel effects that intensify once junction spacing falls below 10 nanometres. The junctionless field-effect transistor removes this constraint by eliminating source-drain junctions, using a uniformly, heavily doped channel switched on and off by gate-controlled depletion and accumulation of carriers. This study presents a three-dimensional technology computer-aided design simulation of a parallel multi-gate junctionless transistor in which four parallel gates, separated by 6-nanometre hafnium dioxide layers, control a 10-nanometre-thick, heavily doped silicon body through 2-nanometre hafnium dioxide gate oxides, over a 60-nanometre gate length. Surface-potential, current-voltage, and transconductance characteristics were extracted for gate biases between 0 and 1 volt. Results show progressive gate-controlled lowering of the channel barrier, well-behaved subthreshold and saturation behaviour, and a transconductance peak consistent with mobility degradation at high vertical field. These results identify the parallel multi-gate, high-permittivity-dielectric architecture as a workable path for further junctionless-transistor scaling.

Keywords: Junctionless transistor; Multi-gate MOSFET; Hafnium dioxide gate dielectric; TCAD simulation; Short-channel effects.

ICEMSET-2026/ST/1038

Influence of Source/Drain Extension Doping on 20 nm Double-Gate Junctionless MOSFETs: A 2D TCAD Study

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Abstract

The source and drain architecture of a junctionless MOSFET governs the trade-off between parasitic series resistance and short-channel control, yet the influence of extension doping is seldom isolated. This work reports a two-dimensional TCAD study of symmetric double-gate junctionless MOSFETs with a 20-nanometre channel, comparing a structure whose source and drain extensions are doped identically to the channel against one whose extensions are an order of magnitude more heavily doped. Devices were constructed in Visual TCAD with a 10-nanometre silicon film, 4-nanometre extensions and silicon dioxide gate oxides of 1, 2 and 3 nanometres, and transfer and output characteristics were extracted over a range of gate and drain biases. Raising the drain bias lowers the threshold voltage in every case, while the more heavily doped extensions deliver substantially higher

drive current and cleaner current saturation. The comparison identifies extension doping, alongside oxide thickness, as a decisive design parameter.

Keywords: Junctionless MOSFET; Source/drain extension; Gate-oxide thickness; TCAD simulation; Short-channel effects.

ICEMSET-2026/ST/1039

PCMs for electronic devices cooling

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Abstract

Commercial electronics usually produce excess heat, hampering long-term usage; making efficient heat removal from such devices essential. Active cooling is not a popular option because of limitations in the overall size of the system due to the miniaturization of electronic components. Thus, passive cooling with heat sinks and PCMs is preferred due to the advantage of the latent heat storage capacity of the PCMs, keeping the base temperature within acceptable limits, without compromise in the compactness of the system. The low thermal conductivity of the PCMs hinders their use. Researchers have been using different methods to increase the heat transfer rate of PCMs, such as adding fins and particles (fillers or foams) as thermal conductivity enhancers (TCEs) for PCMs. Among these options, the use of thermally conductive particles to boost the performance of PCMs is mostly preferred.

Keywords: Electronic cooling; latent heat; energy storage, thermal conductivity enhancers.

ICEMSET-2026/ST/1040

Silicon Carbide MOSFET-Based Three-Phase Inverter Driven Permanent Magnet Synchronous Motor for High-Efficiency Underwater Electric Propulsion

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Abstract

Silicon Carbide (SiC) wide bandgap semiconductor devices has become siginificantlypivotal for high efficiency underwater marine applications.This paper presentsVoltage Source Inverter (VSI) using SiC MOSFETs for the propulsion ofPermanent Magnet Synchronous Motor (PMSM).The performance of the SiC-based three-phase inverter was evaluated by analyzing the input voltage and current, output voltage and current, switching characteristics, conduction and switching losses, junction temperature, and thermal distribution.The influence of SiC material properties including low switching losses, high-frequency operation, improved thermal management, and high efficiency. A SiC MOSFET based three-phase inverter is an excellent choice for underwater PMSM propulsion because of its high-frequency operation produces smoother phase currents, reducing torque ripple, acoustic noise, as well as and mechanical vibration while maintaininf propulsion efficiency and dynamic response. The reduced power losses enhance battery utilization and extend mission endurance. The compact inverter and miniaturized passive components reduce the size and weight of the driving system. The designed highly efficient SiC based inverter with PMSM motors is more suitable for underwater electric propulsion applications.

Keywords: Silicon carbide MOSFET, Permanent Magnet Synchronous Motor, Voltage Source Inverter, Underwater electric propulsion.

ICEMSET-2026/ST/1041

AI-Enabled Quantum-Aware Security Challenges in Microfluidics: Origins, Advances, and Future Perspectives

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Abstract

Microfluidic embedded with sensors is a lab-on-a-chip IoT discipline used as a smart system in the fields of healthcare, biochemical, and molecular biology. These smart systems integrate the formal processes onto a single chip. Thus, these have an immense market potential for drug therapy, clinical testing, DNA sequencing, and many more operations. Microfluidic biochips market is growing exponentially, so these are quite vulnerable to various security threats. Thus, it is of great importance to protect and detect security loopholes surrounding biochips. Like other digital circuits, biochips are susceptible to various attacks, especially hardware level threats like Hardware Trojans, IP Piracy, Reverse Engineering, Side-channel, and many more threats. This paper explores the domain of security and privacy threats in microfluidics and concerned challenges in securing a biochip. It explores the next-generation and hardware security threats based on Artificial Intelligence and Quantum techniques for a sustainable and trustworthy safe point-of-care diagnostics.

Keywords: Microfluidic biochips; Trojans; security; piracy; Quantum concept; machine learning; man-in-the-middle-attack; deep learning.

ICEMSET-2026/ST/1042

Nanomaterial-Based Biosensors for Point-of-Care Diagnostics: Current Progress and Emerging Applications

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Abstract

Nano-biosensors combine biological recognition molecules with nanomaterials, such as carbon nanotubes, gold nanoparticles, quantum dots, and magnetic nanoparticles, offering greater sensitivity than conventional biosensors, with a bioreceptor, transducer, and electronic signal-processing unit as core components. To review the design principles, mechanisms, and clinical applications of nanomaterial-based biosensors in point-of-care diagnosis of infectious diseases and lifestyle disorders, and evaluates their bioreceptor-transducer components and optical detection mechanisms for biomarker sensitivity, selectivity. Effective highlights strong diagnostic performance across pathogens and disease biomarkers, and points to future directions in miniaturization, standardization, and expanding early-stage disease detection. A literature search of PubMed, Springer, Google Scholar, and ResearchGate (2020-2026) using terms including “point-of-care testing,” “biosensor,” and “nanotechnology” identified studies on detection mechanisms, fabrication approaches, and biomarker-specific strategies. Nano-biosensors showed strong sensitivity and selectivity, including FET-based immunosensors for viral detection, piezoelectric sensors for bacterial identification, and platforms detecting cancer, inflammatory, and neurological biomarkers such as amyloid-β and tau protein. Nano-biosensors offer rapid, accurate point-of-care diagnostics; future work should focus on miniaturization, standardization, and expanding early-stage detection of hard-to-diagnose conditions.

Keywords: Nano-biosensors; Disease diagnosis; Point-of-care testing; Electrochemical biosensors; Optical biosensors.

ICEMSET-2026/ST/1043

Copper Nanoparticle-Based Nanozymes: An Emerging Biomedical Frontier in Neurodegenerative Disease Therapy

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Abstract

Copper is an essential trace element and enzymatic cofactor, which drives oxidative stress, amyloid-β & α-synuclein aggregation, and mitochondrial dysfunction underlying neurodegeneration leading to disrupted CNS homeostasis. Copper-based nanozymes enzyme-mimetic nanoparticles exploiting copper's variable oxidation states offer a tunable strategy to modulate this diseased redox microenvironment. This review appraises copper nanozymes role in modulating copper dyshomeostasis, ROS scavenging, and mitochondrial dysfunction in neurodegenerative disease, alongside their emerging biomedical applications. A literature search of PubMed, ScienceDirect, Google Scholar, and Nature (2020–2026) using keywords "copper nanoparticles," "nanozymes," "neurodegenerative diseases," and "biomedicine" identified studies on the catalytic mechanisms and applications of copper nanozymes, which were critically evaluated. Copper nanozymes exhibit chemical-state-dependent, dual-mode redox behaviour: in pro-oxidant mode, self-cascading Cu-nanozymes deplete glutathione and induce cuproptosis, driving mitochondrial dysfunction; in antioxidant mode, SOD-catalase-mimetic nanozymes scavenge ROS and attenuate amyloid-β & α-synuclein aggregation, indicating neuroprotective potential in neurodegeneration. Copper nanozymes represent a promising nanomedicine platform with antioxidant, ROS-scavenging, and neuroprotective potential, alongside established biosensing, antimicrobial, and anticancer applications. Limited blood–brain barrier permeability and biosafety concerns remain key translational barriers, warranting future focus on brain-targeted delivery and clinical validation for neurodegenerative disease diagnostics and therapeutics.

Keywords: Copper Nanoparticles, Nanozymes, Neurodegenerative Diseases, Biomedicine.

ICEMSET-2026/ST/1044

Improvement of Responsivity of a Photodetector through Micro-Engineering of the Electrode Geometry

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Abstract

Conventional photodetectors primarily employ rectangular interdigitated electrodes (IDE), which often suffer from effective shadowing and nonuniform electric field distribution. To address this, tapered electrode architectures, specifically curved, spherical, and elliptical geometries, were studied to achieve a higher responsivity. By maximizing the active illumination window, the tapered electrode enhances direct photon penetration into the underlying semiconductor, increasing photocarrier generation rates. Using a β-Ga_2O_3 photodetector, 3D TCAD analysis demonstrates that the increase in illumination window is not the only factor to achieve the greater responsivity. Explicitly, a linear increase in responsivity (~2 times, ~23 times, and ~24 times) is not always due to a linear increase in illumination area (~5%, ~7%, and ~11%). The electric field distribution plays a crucial role here through crowding at the electrode boundary and Shockley-Read-Hall recombination of the photogenerated carriers. The obtained electric field contours offer such intricated insight to determine the physical mechanistic framework. The study shows an approach towards design considerations of IDE for photodetectors.

Keywords: Electrode geometry; TCAD simulation; β-Ga_2O_3 photodetector; Responsivity; Interdigitated electrode.

ICEMSET-2026/ST/1045

Real-time Implementation of a Low-cost IoT-enabled Automated Fabric Defect Detection System by Robust Principle Component Analysis

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Abstract

Quality control is an essential requirement in textile industry where different types of fabric defects can greatly reduce the product quality. This paper presents a Low-Cost Automated Fabric Defect Detection System that utilizes computer vision and Internet of Things technologies to detect fabric defects and notify the user automatically. The proposed system uses a webcam to capture fabric images and applies Robust Principal Component Analysis combined with Median Filtering to identify defects by separating normal fabric textures from defective regions. An ESP32 microcontroller controls the conveyor motors and coordinates the inspection process. When a defect is detected the system stops the conveyor and sends a notification through a Telegram Bot and uploads the defective image to Dropbox cloud storage for documentation. If no defect is found, the conveyor continues to move the fabric roll for further inspection. The proposed system improves inspection accuracy, reduces human involvement and enables real-time monitoring.

Keywords: Fabric Defect Detection, Computer Vision, Robust Principle Component Analysis, Median Filter, Internet of Things.

ICEMSET-2026/ST/1046

Anderson Localization in Modified Three-Dimensional Lattices: Interplay of Coordination, Disorder, and Coulomb Trapping

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Abstract

Anderson localization provides a fundamental framework for understanding disorder-driven metal–insulator transitions in quantum systems. Here, we computationally investigate localization in modified three-dimensional lattices with enhanced coordination and examine how the resulting disorder-induced localization competes with localization produced by an attractive Coulomb center. We first study lattices with seven and eight nearest neighbors using finite-size scaling to characterize the Anderson transition. The critical disorder strength increases systematically with coordination, with $W_c=18.4\pm0.3$ for the seven-nearest-neighbor lattice and $W_c=20.7\pm0.3$ for the eight-nearest-neighbor lattice, demonstrating that enhanced connectivity stabilizes extended states against disorder. We then extend the model to a polaronic system by introducing a nearby counterion that generates an attractive Coulomb potential. Using realistic hopping amplitudes and lattice parameters, we characterize the interplay between Coulomb trapping and random disorder through the inverse participation ratio. Strongly localized low-energy bound states emerge around the Coulomb center, whereas increasing disorder progressively drives the system toward a disorder-dominated localization regime. These results demonstrate how lattice connectivity, electrostatic interactions, and disorder collectively control localization and provide a computational framework for understanding localized electronic states in quantum and molecular materials.

ICEMSET-2026/ST/1047

Sustainable Synthesis of Cu-Doped ZnO Nanoparticles Using *Nyctanthes arbor-tristis* Leaf Extract: Structural and Morphological Insights

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Abstract

The growing demand for sustainable nanomaterials has stimulated increasing interest in plant-mediated synthesis as a greener alternative to conventional nanoparticle fabrications. In the present study, copper-doped zinc oxide (Cu–ZnO) nanoparticles offer a promising platform owing to the tunable physicochemical properties imparted by Cu incorporation into the ZnO lattice. In this study, copper-doped zinc oxide (Cu–ZnO) nanoparticles were synthesized via aqueous leaf extract of *Nyctanthes arbor-tristis* (commonly known as Harshringar). The bioactive phytoconstituents present in the plant extract facilitate the formation and stabilization of nanoparticles, thereby minimizing the need for potentially hazardous chemical reagents. The structural characteristics of the synthesized nanoparticles were examined by X-ray diffraction (XRD), which revealed the characteristic hexagonal wurtzite crystal structure of ZnO. No additional diffraction peaks associated with secondary crystalline phases were detected within the resolution of the measurement, suggesting the successful formation of Cu-doped ZnO without detectable secondary phases. Changes in diffraction peak position and intensity with increasing Cu concentration indicated modifications in the ZnO lattice arising from Cu incorporation and associated lattice distortion. The average crystallite dimensions were estimated using the Debye–Scherrer method. Surface morphology was further investigated using Field Emission Scanning Electron Microscopy (FESEM). The micrographs exhibited predominantly spherical to irregularly shaped particles with noticeable agglomeration which is commonly associated with biogenic nanoparticle synthesis. Variations in surface morphology and grain characteristics were observed upon increasing Cu concentration that shows the influence of dopant incorporation on particle growth as well as surface structure. This demonstrates that *Nyctanthes arbor-tristis* leaf extract can serve as an effective capping and stabilizing agent for the synthesis of Cu-doped ZnO nanoparticles which highlights their potential for applications in catalysis, sensing, and environmental remediation.

Keywords: Copper-doped ZnO, *Nyctanthes arbor-tristis*, plant-mediated synthesis, XRD, FESEM, nanomaterials.

ICEMSET-2026/ST/1048

Performance of Okra Seed Extract as a Natural Bio-Coagulant for the Remediation of Physico-Chemical Parameters of Wastewater

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Abstract

Industrial wastewater contains high levels of different chemical pollutants that are often discharged untreated, threatening aquatic ecosystems. This study explores the performance of okra seed extract as a natural bio-coagulant for the remediation of physic-chemical parameters of wastewater. In this work, the potential of okra (*Abelmoschus esculentus*) seeds powder coagulant solution was tested for their ability to remove the hardness, pH, turbidity, metal concentrations and total dissolved solids. Turbidity, hardness and total dissolved solids were removed effectively with an optimum dosage of coagulant solution. The maximum removal efficiency for Hardness, Turbidity, Total dissolved, Solids, Lead (Pb^{+2}) and Cadmium (Cd^{+2}) are 73%, 62.4%, 83.4%, 49.1% and 81.1% respectively. FTIR analysis indicated that okra seed extract showed a broad band around 3000-3500 cm^{-1} range is characteristic of (–OH) functional group of polysaccharides peak. FTIR, FESEM and DLS results demonstrate the potential of okra seed extract as a sustainable, plant-based natural bio-coagulant for effective remediation of physico-chemical parameters of wastewater.

Keywords: Okra (Abelmoschus esculentus); coagulant; turbidity; hardness; TDS.

ICEMSET-2026/ST/1049

Emerging Technologies for Safeguarding Intelligent Systems

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Abstract

The accelerating confluence of emerging technologies such as Artificial Intelligence, the Internet of Things, autonomous systems, Large Language Models, and modern cryptographic techniques is restructuring intelligent systems across diverse technical sectors. Parallel to the gains in automation, efficiency, and decision-making these technologies yield, these introduce pressing challenges around cybersecurity, privacy, trust, and system resilience. This paper highlights the advances in secure authentication mechanisms, transparency across the AI lifecycle, UAV-enabled intelligent monitoring, credible LLM-driven recommender systems, and validated cryptographic frameworks. Together, these findings demonstrate how incorporating advanced security mechanisms across intelligent digital infrastructures can fundamentally strengthen the reliability and resilience of today's digital ecosystems. The paper further reflects on shared methodologies, evolving technological trends, unaddressed research gaps, and promising directions for future work across the gathered reviews. Principally, this paper emphasizes the requirement of multidisciplinary, by-design security frameworks thinking in building intelligent systems that are secure, scalable, transparent, and genuinely trustworthy.

Keywords: Artificial Intelligence; Internet of Things; Large Language Models; Cybersecurity; Secure Authentication; Cryptographic Frameworks; AI Lifecycle transparency.

ICEMSET-2026/ST/1050

Ultrasound –Assisted Synthesizing Sulfhydryl-Functionalized Sugarcane Bagasse Ash for Efficient Adsorption of Heavy Metals from Wastewater

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Abstract

A ultrasound-assisted Sulfhydryl (-SH) functionalized sugarcane bagasse ash (SFSBA) is successfully synthesized by a facile, efficient, and environmentally friendly process using 3-mercaptopropyltrimethoxysilane (MPTS). It may be concluded that the ultrasound-assisted Sulfhydryl (-SH) functionalized material have been fabricated through a fast and effective, process, which has not been reported earlier. The effects of adsorbent dosage, pH, and contact time on adsorption were examined. Material structure and adsorption mechanisms were dissected by virtue of advanced characterization techniques FT-IR, XRD, FESEM, DLS, TGA and DSC. The synthesized material proves to be an effective and selective adsorbent for removal of Cd^{+2} and Cu^{+2} ions from aqueous solution. It is also noticed that the Langmuir equation provides an accurate description of the sorption data, implying that monolayer sorption took place during adsorption. The quick and excellent uptake capacities of the sorbent can be described on the basis of the hard and soft acid-base principle (HSAB) and electrostatic attraction. Finally, synthesis of the low cost biosorbent with high adsorbent efficiency is also the prime point of interest in this research work. Batch experiments performed in the presence of ultrasound to investigate the degree of intensification as compared to the conventional agitation-based treatment revealed that the adsorption rate significantly increases in the presence of ultrasound. Kinetics and isotherm study revealed that all the experimental data was found to best fit the pseudo second order kinetics and Langmuir adsorption isotherm model respectively.

Keywords: SFSBA; SFSBA; MPTS; HSAB; Ultrasound.

ICEMSET-2026/ST/1051

Square Patch and Square Resonator with Slit based Dual-band with merged Broad-band Metamaterial Absorber for X-band Applications

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Abstract

Since the inception of theoretical concept about the materials with negative permittivity and permeability in 1968 to realization of first metamaterial-based microwave absorber in 2008, to till date quite significant research has been done to improve the design and performance of the metamaterial absorber (MMA) from narrow-band to multi-band and broad-band with polarization and angle of incidence independent metamaterial absorber. The manuscript presents a novel design of a three-layered metamaterial absorber that exhibits two absorptance bands one at 9.126 GHz and other at 10.458 GHz. The novel design consists of outer square resonator with slits connected to inner square patch diagonally. The Two absorptance bands merge to generate a broad-band of -10 dB bandwidth of 2.46 GHz. The overall unit cell dimensions of proposed MMA is 6mm by 6mm. The outer square resonator is 5.35mm by 5.35mm and inner square patch is 3.95mm by 3.95mm that finds application in Stealth technology.

Keywords: Absorptance, Broad-band, Dual-band, Metamaterial Absorber.

ICEMSET-2026/ST/1052

Phonon Confinement Induced Redshift in Nickel-Negative-ion-Implanted InP

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Abstract

In this work we present a comprehensive Raman-spectroscopic study of undoped n-type InP(100) wafers implanted with negative nickel ions (Ni^-) at 70 keV with different ion fluences ranging from 5×10^{15} to 1×10^{17} ions cm^{-2}. First-order Raman spectra observed with laser of 532 nm excitation revealed a systematic red-shift of the longitudinal-optical (LO) phonon modes from 341.84 cm^{-1} in the unimplanted sample to 335.39 cm^{-1} at the 1×10^{17} ions cm^{-2} fluence, with a four-fold broadening of the LO mode. We used the Phonon Confinement Model (PCM) to quantitatively understand the observed red-shift and stress-induced shift arising from strain due to the near-surface layer implantation. We obtained phonon coherence lengths L as 0.98 nm, 1.02 nm, 1.01 nm and 0.92 nm for samples of InP implanted with Nickel negative ions at fluences $5x10^{15}$, $1x10^{16}$, $5x10^{16}$, and $1x10^{17}$ ions cm^{-2} respectively indicating a nano-crystalline structure. The PCM study reveals that major part of the observed Raman red-shift is in accordance with the results obtained from phonon confinement model. Our results highlight the essential role of a proper PCM study when interpreting implantation-induced Raman shifts in Nickel negative ion implanted InP semiconductor.

Keywords: Indium phosphide; Negative-ion implantation; Raman spectroscopy; Phonon Confinement Model; Coherence length.

ICEMSET-2026/ST/1053

Simulating Non-Newtonian Viscosity Effects in MEMS-Scale Microchannel Flows

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Abstract

At the microscale, the elevated shear rates generated within confined channels (like MEMS (micro-electromechanical systems) geometries) interact with the fluid's shear-dependent viscosity, giving rise to

nonlinear flow phenomena even under very low-Reynolds-number conditions. In this work, laminar, incompressible and non-isothermal polymer melt flow in sudden expansions is studied numerically. The equations are solved using the generalized Newtonian model with Cross and Modified Arrhenius Power-Law rheology using second-order finite difference approximation while taking care of pressure and velocity coupling using the Poisson equation. By accurately forecasting the recirculation zone, flow gradients, and thermal dissipation, the MAPL model demonstrates its capability to handle the intricate balance of fluid inertia, elastic recovery, and thermal dynamics inherent to industrial-scale polymer flows.

Keywords: MEMS; Cross model; MAPL model.

ICEMSET-2026/ST/1054

Study of Phase Structure and Corrosion Resistance of Electroless Ni-P-ZrO_2 Nanocomposite Coatings on Mild Steel

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Abstract

The storage of radioactive waste required long-term capacity and get affected by the corrosion and may persist problem for sustainable environment Therefore, accurate corrosion diagnosis is required for efficient monitoring and safety of nuclear power plants due to ability of reducing the strength of structural components composed of mild steel used. One potential reason why a substance could break down is corrosion brought on by radiation. Several electrochemical experiments and corrosion tests were used to look into the composition, thickness, and metal cations dissolved in the oxide that is generated during corrosion. An attempt has been carried out to study to understand the corrosion characteristics in mild steel material of the AISI1040 grade. Metal was coated with 4.0 gpl of finely synthesised zirconium oxide (ZrO2) nanoparticles that had been irregularly scattered within an acidic electroless Ni-P matrix. The entire deposition duration of 1.5 hours was chosen, and thicknesses of Nano composite depositions were found to range from 9 to 12 micrometre metres. The morphology, elemental composition, and phase structures of these Ni-P- ZrO2 nanocomposite depositions were examined using the scanning electron microscope, energy dispersive spectroscopy, and X-ray diffraction technologies. The findings of these experimental tests demonstrated the presence of powerful ZrO_2 nanoparticles in the form of white globules in the electroless Ni-P matrix placed on the MS surface. The as-deposited depositions exhibited primarily amorphous morphologies, whereas heated depositions at temperatures between 200 and 400 degrees Celsius in steps of 200 degrees displayed predominately crystalline morphologies. In an argon atmosphere, the coatings amorphous to crystalline structural get changed. Similar in type, Ni-P-ZrO_2depositions heated to 200°C can be seen in SEM. This combination of electrochemical and surface studies provided a full knowledge of mild steel corrosion.

Keywords: Electroless, Ni-P-ZrO_2depositions, electrochemical, corrosion.

ICEMSET-2026/ST/1055

AI-Assisted Multi-Objective Optimization of Ceramic Heat Sinks for High-Power Electronic Thermal Management

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Abstract

The increasing power density of modern electronic systems including quantum computing hardware, artificial-intelligence accelerators and high-performance computing systems, demands thermally efficient and reliable

heat-sink materials. High-conductivity ceramics offer a promising alternative to conventional metals, combining thermal performance with electrical insulation, low density, corrosion resistance, and mechanical stability. This work proposes an AI-assisted framework for selecting high-conductivity ceramics for high-power electronic thermal management. First-principles material data from the Materials Project are used to characterize candidate materials based on their temperature-dependent thermophysical and mechanical properties. A validated conjugate heat-transfer computational fluid dynamics model is then employed to evaluate ceramic heat-sinks under identical operating conditions representative of a 450 W high-power workstation. Thermal and flow characteristics, including junction temperature, thermal resistance, temperature distribution, and pressure drop, are systematically quantified. The resulting database is used to develop a deep-learning surrogate model for rapid performance prediction, while SHAP-based explainable artificial intelligence identifies the dominant material and operating parameters. Finally, multi-objective particle swarm optimization is employed to identify Pareto-optimal ceramics considering thermal performance, weight, manufacturability, cost, and mechanical reliability. The proposed framework provides intelligent decision-support for selecting advanced functional cermaics for thermal management of high-power electronic devices.

Keywords: Thermal Management Materials; High-Conductivity Ceramics; Computational Fluid Dynamics; Heat Sinks; Machine Learning for Electronic Materials.

ICEMSET-2026/ST/1056

Vibrational and Ultrasonic Study of Thorium Nitrides (ThN)

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Abstract

Thorium nitride (ThN) lattice dynamic behaviour was examined to determine its structural stability and thermodynamic properties at different thermodynamic conditions. Phonon dispersion relations were computed to explore dynamic stability; wherein no imaginary frequencies were detected along the Brillouin zone. Phonon density of states (PDOS) and combined density of states also reflect Th and N atom contributions to vibrational modes, which in turn get correlated with Raman-active and infrared-active observed phonon frequencies. Elastic properties of ThN were explored through third- and fourth-order elastic constant and pressure derivative measurements, useful information on anharmonic effects and mechanical stability under compressive stress. The Debye temperature, which is obtained from mean sound velocities, agrees with phonon spectra and provides an accurate estimate of lattice vibrational behaviour. Constant volume specific heat capacities (Cv) were determined by phonon density of states based on the quasi-harmonic approximation. In general, current lattice dynamics provides a thorough description of the elastic, vibrational, and thermodynamic aspects of ThN and determines its possible use in nuclear materials and future ceramic devices.

Keyword: Thermophysical properties, elastic constants, elastic moduli, Debye temperature and phonon interaction.

ICEMSET-2026/ST/1057

Structural, Optical and Luminescence Studies of Eu-Doped PVP–Y_2O_3 Nanocomposites for Optoelectronic Applications

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Abstract

Polymer–metal oxide nanocomposites have attracted significant interest because of their ability to combine the useful properties of polymers with the structural and optical characteristics of metal oxides. In this work, PVP–Y_2O_3 nanocomposites with different Eu doping concentrations were prepared to investigate the influence of Eu incorporation on their structural and optical properties. The prepared samples were characterized using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), UV–visible spectroscopy, and photoluminescence (PL) spectroscopy. XRD analysis was used to examine the structural characteristics of the Y_2O_3-based nanocomposites and to evaluate the changes associated with Eu doping. FTIR spectroscopy

confirmed the characteristic functional groups of PVP and the interaction between the polymer matrix and Y_2O_3 nanoparticles. UV–visible spectroscopy was employed to study the optical absorption behaviour and the changes in optical properties resulting from Eu incorporation. The photoluminescence spectra showed noticeable changes in emission behaviour with Eu doping, indicating the role of Eu ions in modifying the optical response of the PVP–Y_2O_3 system. The interaction between PVP, Y_2O_3, and Eu ions resulted in changes in the structural and optical characteristics of the nanocomposites. Overall, the study demonstrates that Eu doping provides an effective approach for tuning the optical and luminescence properties of PVP–Y_2O_3 nanocomposites, making these materials promising candidates for potential optoelectronic and photonic applications.

Keywords: PVP, Y_2O_3, Nanocomposites, Photoluminescene, Optoelectronic applications.

ICEMSET-2026/ST/1058

Cognitive AI Framework for Automated Classroom Attendance Using Dynamic Imaging and Face Recognition

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Abstract

The traditional Educational Institutions record student attendance on hourly basis, twice/trice in a day which is a repetitive task. The faculty spend part of their class allocated time for attendance recording by calling the names of the students or the registration numbers of the student, which is leading to lot of time consumption, disturbance in effective content delivery and may also lead to human errors. Keeping this as a challenge, this paper provides an AI solution for attendance recording system that operates in the classroom premises. This AI – Solution builds an attendance system which is automated and is operated in the classroom without any intervention of the any human for the attendance recording. In the Proposed system, a camera in installed in the classroom above the lecture board where this camera moves from left to right or vice versa. The attendance record is collected in regular intervals as per the instructor or institute guidelines excluding the break of the institute. The camera captures the students' images and compares them with the pretrained database. Deep Learning Face Recognition algorithms are used for the identification of the features and comparison. If the student is identified and matched in all the intervals of attendance scanning through the mounted camera, then the students are marked as present for all the class hours on that day. The same camera can be used for the recording purpose of the lecture and as surveillance. Therewith, this results in avoiding biometric devices, RFIDs for student attendance recording.

Keywords: Automated Attendance System, Artificial Intelligence, Face Recognition, Deep Learning, Computer Vision, Smart Classroom, Educational Technology, Classroom Monitoring, Indian Education System.

ICEMSET-2026/ST/1059

Theoretical Investigation of Elastic and Ultrasonic Properties of Oxygen-Terminated MXenes within the Van der Waals Three-Body Force Shell Framework

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Abstract

Oxygen-terminated MXenes, $Ti_3C_2O_2$, Nb_2CO_2, and Mo_2CO_2, represent an emerging class of synthetic two-dimensional materials with promising applications in nanoelectronics, sensing, energy storage, and thermal management. Their performance under varying thermal conditions is closely associated with lattice dynamics, elastic stability, and phonon-mediated behaviour, making a detailed understanding of these properties essential. In the present study, the thermoelastic, ultrasonic, and lattice dynamical characteristics of these MXenes are investigated within the Van der Waals three-body force shell (VTBFS) framework. The analysis incorporates

second-, third-, and fourth-order elastic constants to explore their linear and anharmonic elastic response, together with temperature-dependent ultrasonic properties and phonon density of states. The comparative investigation is aimed at revealing how interatomic interactions and lattice anharmonicity govern the mechanical, vibrational, and thermal behaviour of these emerging two-dimensional systems. By establishing a connection between microscopic lattice interactions and temperature-dependent macroscopic properties, the present work provides a theoretical basis for understanding the stability and functional response of oxygen-terminated MXenes under thermally varying conditions. Such insights may be valuable for guiding the development of MXene-based materials and devices where mechanical robustness, phonon dynamics, and thermal stability are critical.

ICEMSET-2026/ST/1060

From Materials to Quantum Processors: A Review of Fabrication, Decoherence and Scalability in Superconducting Qubits

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Abstract

Quantum computing offers computational capabilities beyond classical computing through superposition, entanglement, and quantum interference. This paper reviews superconducting quantum processors from a materials science perspective, with emphasis on transmon qubits, Josephson junctions, and fabrication technologies. It explains how Cooper-pair tunnelling and anharmonic energy levels enable stable and controllable qubit states. The operational workflow, including cryogenic cooling, qubit initialization, microwave control, gate execution, readout, classical processing, and error management, is outlined. Material purity, thin-film deposition, substrate quality, interfaces, and dielectric losses are identified as key factors affecting qubit co-herence and gate fidelity. Major challenges include decoherence, crosstalk, cryogenic wiring, calibration drift, control complexity, and the overhead of quantum error correction. Supercon-ducting quantum processors are expected to complement CPUs and GPUs in hybrid architec-tures for quantum simulation, molecular modelling, cryptography, and optimization, requiring advances across materials science, nanofabrication, cryogenics, electronics, and software.

Keywords: Superconducting quantum processors; Transmon qubits; Josephson junctions; Quantum materials; Quantum coherence.

ICEMSET-2026/ST/1061

Green-Synthesized Transition Metal Oxide Nanostructures for Sustainable Supercapacitor Applications

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Abstract

The growing demand for efficient and sustainable energy-storage technologies has increased interest in supercapacitors with high power capability, rapid charge–discharge rates, and long cycle life. Transition metal oxides (TMOs) are promising electrode materials because of their rich redox chemistry and ability to deliver high specific capacitance. However, conventional synthesis routes often involve toxic chemicals, high energy consumption, and complex processing steps, which can limit their environmental sustainability. Green synthesis has therefore emerged as an attractive approach for producing TMO nanostructures using plant extracts, biomass, and other renewable resources as reducing, stabilizing, or capping agents. This approach can provide

better control over particle size, morphology, surface chemistry, and structural properties while reducing the environmental impact of material preparation. Green-synthesized MnO_2, NiO, Co_3O_4, Fe_2O_3, and related oxide nanostructures have demonstrated considerable potential for supercapacitor electrodes owing to their enhanced electroactive surface area and improved ion and electron transport. This review highlights recent advances in green synthesis strategies for TMO nanostructures and discusses their relationship with structural characteristics and electrochemical performance. Particular emphasis is placed on synthesis mechanisms, morphology control, electrode design, specific capacitance, energy and power density, and cycling stability. The challenges and future prospects of green-synthesized TMO electrodes for sustainable and high-performance supercapacitor applications are also discussed.

Keywords: Green synthesis; Transition metal oxides; Nanostructures; Supercapacitors; Electrochemical energy storage; Sustainable materials.

ICEMSET-2026/ST/1062

Deposition of titanium-based films using colliding pulsed laser deposition system

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Abstract

The expansion dynamics of colliding titanium plasma plumes were investigated at ambient pressures ranging from (10^{-5}) to 10 mbar using time-resolved 2D imaging. At low pressure, the plume showed rapid forward expansion with velocities of the order of (10^{4}) cm/s, whereas increasing pressure caused significant plume confinement due to enhanced plasma–ambient collisions. Colliding-plasma pulsed laser deposition was also employed to deposit titanium-based thin films in air. XRD and EDX analyses indicated the presence of Ti, N, and O, suggesting the formation of titanium nitride/oxynitride phases. The deposited films exhibited high optical transmittance (~90%) in the 400–700 nm range. The results demonstrate the influence of ambient pressure on plasma dynamics and the potential of colliding plasma deposition for synthesizing titanium-based multicomponent thin films.

Keywords: Titanium nitride. Thin film deposition.

ICEMSET-2026/ST/1063

Hybrid Electrolyte Engineering for Enhanced Supercapacitor Performance

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Abstract

The growing need for efficient and sustainable energy-storage systems has encouraged extensive research on supercapacitors because of their high power-delivery capability, fast charge–discharge characteristics, and extended cycling durability. Their electrochemical performance, however, depends strongly on the electrolyte, which influences ionic transport, electrochemical stability, operating voltage, and interactions at the electrode–electrolyte interface. Conventional aqueous electrolytes generally provide good ionic conductivity but have a limited electrochemical stability window. Organic and ionic-liquid electrolytes can offer a wider operating voltage range, although their higher viscosity, cost, and comparatively lower ion mobility may limit practical performance. Against this background, hybrid electrolytes have attracted considerable attention as an effective approach for combining the beneficial features of different electrolyte systems. Recent studies indicate that aqueous/organic, ionic-liquid/organic, and hybrid gel-electrolyte configurations can alter ion transport, solvation behavior, interfacial stability, and electrolyte–electrode compatibility. These characteristics directly affect charge-storage kinetics and, consequently, the capacitance, rate capability, energy density, power output, and

cycling durability of supercapacitors. This work examines how hybrid electrolyte composition and associated physicochemical properties influence supercapacitor performance and discusses electrolyte engineering as a potential route toward safer, stable, and efficient energy-storage devices.

Keywords: Hybrid electrolytes; Supercapacitors; Ion transport; Electrochemical stability; Energy density; Charge storage.

ICEMSET-2026/ST/1064

Structural, Dielectric, and Magnetic properties in novel (0.5) $BaTiO_3$- (x) $Na_{0.5}Bi_{0.5}TiO_3$-(1-x) $Ba_{0.5}Sr_{0.5}F_{12}O_{19}$ multiferroic composites

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Abstract

The novel triphasic (0.5) $BaTiO_3$–(x)$Na_{0.5}Bi_{0.5}TiO_3$–(0.5−x) $Ba_{0.5}Sr_{0.5}Fe_{12}O_{19}$ composite system (x = 0.1, 0.2, 0.3, and 0.4) was synthesized using the 'solid-state method'. XRD analysis combined with Rietveld refinement verified the formation of pure triphasic composites without the presence of secondary impurity phases. The samples exhibit an inhomogeneous grain packing with 'average grain size' which lies in the range of approximately 0.40 to 0.65 μm, which increases typically with increasing $Na_{0.5}Bi_{0.5}TiO_3$ content. The ε′ exhibited lower frequency dispersion and increased with higher $Na_{0.5}Bi_{0.5}TiO_3$ content, reaching a maximum value of approximately 2750 at 450 °C for the composite with x = 0.4. The temperature-dependent 'dc conductivity' demonstrated the behavior consistent with an Arrhenius relation. VSM analysis shows that with the addition of hexaferrite phase in the ferroelectric phases, all the magnetic parameters increase as ferrite being the center of magnetization and the non-magnetic ferroelectric phases acquired the magnetic properties.

Keywords: XRD, Rietveld Refinement, Dielectric Properties, VSM, DC Conductivity.

ICEMSET-2026/ST/1065

Enhanced Magnetic and Dielectric Behavior in Dy^{3+} Doped Y-Type Hexaferrites Synthesized by Sol–Gel Auto-Combustion

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Abstract

This study explores the synthesis of Dy^{3+} ions doped Barium Y-type hexagonal ferrites having empirical formula $Ba_2Ni_2Fe_{12-x}Dy_xO_{22}$, where x = 0.0, 0.025, 0.050, 0.075 and 0.10 using the sol-gel auto-combustion process. XRD analysis confirmed a pure hexagonal Y-phase structure with crystallite size range of 10.67 – 26.44 nm due to optimal lattice stabilization. The dc conductivity follows the Arrhenius plot and BNFDO3 is found to have highest activation energy among all samples. Dielectric analysis was conducted with frequency range of 100 Hz to 5 MHz. Both the dielectric constant (ε′) and loss tangent (tanδ) decrease as applied frequency increases. Dy^{3+} doping enhances high-frequency performance, by boosting the electrical resistivity and reducing the Fe^{3+} / Fe^{2+} hopping conduction which leads to lower dc conductivity and dielectric losses at higher frequencies. The magnetic properties, including saturation (M_s), remanence (M_r) and coercivity (H_c), squareness ratio (SR) were measured.

Keywords: Hexagonal, XRD, DC conductivity, Dielectric, VSM.

ICEMSET-2026/ST/1066

Structural and Electrical properties of Dy^{3+} doped SNN tungsten bronze ferroelectrics ceramics

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Abstract

Strontium sodium niobate (SNN)-based tungsten bronze ferroelectric ceramics with dysprosium (Dy) rare-earth doping were synthesized by the conventional solid-state reaction method. The incorporation of Dy^{3+} ions into the SNN lattice was investigated to understand its influence on the structural and electrical properties of the ceramics. X-ray diffraction (XRD) analysis was carried out to identify the crystalline phase, structural characteristics, and possible changes in the lattice parameters resulting from Dy substitution. The XRD patterns were analysed to confirm the formation of the tungsten bronze structure and to examine the phase purity of the prepared samples. In addition, DC conductivity measurements were performed over a suitable temperature range to investigate the charge transport mechanism and electrical conduction behaviour. The temperature dependence of DC conductivity points towards the semiconducting nature of the synthesized samples.

Keywords: XRD, DC Conductivity, Lattice Parameters, Crystalline Phase, Semiconducting Nature.

ICEMSET-2026/ST/1067

MediDrone: An Intelligent Drone-Based Emergency Medical Response and Smart Triage System

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Abstract

Emergency healthcare response can be delayed by traffic congestion, geographical barriers, limited healthcare infrastructure, and communication difficulties, particularly in rural and underserved regions. Existing approaches often address individual functions such as triage, telemedicine, patient monitoring, or medical delivery without integrating them into a unified emergency-response workflow. This paper presents MediDrone, a prototype emergency healthcare framework integrating rule-based AI-assisted triage, simulated drone-supported medical response, telemedicine, patient-vitals monitoring, GPS/BLE-based localization, multilingual communication, and accessibility support. The prototype was evaluated through controlled simulation experiments involving 30 emergency-response missions across urban, rural, and remote scenarios. Average response times were 6, 9, and 11 minutes, respectively. In 100 simulated triage cases, high-priority classification achieved 96.7% accuracy, while across 20 GPS-only trials and 20 GPS+BLE trials, hybrid GPS/BLE localization achieved an average positioning error of 1.5 m compared with 8.0 m using GPS alone. These results demonstrate prototype-level feasibility while highlighting the need for real-world, clinical, and regulatory validation.

Keywords: Emergency Healthcare; Drone-Assisted Medical Response; Smart Triage; Telemedicine; Patient Localization.

ICEMSET-2026/ST/1068

Advanced Silica- Encapsulated ZnSe Quantum Dots for Enhanced Photonic Device Performance

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Abstract

Quantum dots (QDs) have emerged as a rapidly advancing class of nanomaterials due to their remarkable optical, electrical, and structural properties, leading to diverse applications across science and technology. This

report presents an overview of the synthesis strategies for fabricating silica-coated quantum dots, with a particular focus on zinc selenide (ZnSe) nanoparticles. Various synthesis techniques such as hydrothermal, co-precipitation, sol-gel, ball milling, and solid-state reactions are explored, each offering unique advantages concerning particle size uniformity, purity, and scalability. ZnSe-based quantum dots demonstrate excellent physical and chemical characteristics, including high thermal stability and a high melting point, making them suitable for use in catalysis, energy storage, scintillation, and data storage applications. The findings suggest that silica-coated quantum dots synthesized through these methods exhibit superior stability and functionality. Continued advancements in synthesis approaches are expected to further enhance their performance, paving the way for innovative applications in modern photonic and optoelectronic devices.

Keywords: Quantum Dots, Silica-Decorated, Synthesis, Applications, Photonics, etc.

ICEMSET-2026/ST/1069

Advanced Crystallographic Characterization of Auto-Combustion Synthesized Forsterite for Functional Materials Applications

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Abstract

Forsterite (Mg_2SiO_4) is an important magnesium silicate ceramic that has attracted considerable interest due to its excellent thermal stability, chemical durability, and potential for functional material applications. In this study, we synthesized undoped forsterite using a simple, cost-effective auto-combustion method. We investigated the structural and phase characteristics of the synthesized material using powder X-ray diffraction (XRD). Rietveld refinement was employed to obtain detailed information about the crystal structure and to evaluate the agreement between the experimental and calculated diffraction profiles. The refined structural parameters confirm the formation of the orthorhombic forsterite phase. The results demonstrate the effectiveness of the auto-combustion route for synthesizing crystalline Mg_2SiO_4 with well-defined structural characteristics. This study provides a structural foundation for further investigations of doped forsterite systems and their potential applications in functional and luminescent materials.

Keywords: Forsterite; Mg_2SiO_4; Auto-combustion; XRD; Rietveld refinement; Crystal structure etc.

ICEMSET-2026/ST/1070

Structural, Dielectric and Electrical properties of KNN based multiferroic composites for Multifunctional Devices

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Abstract

Potassium sodium niobate, $K_{0.5}Na_{0.5}NbO_3$ (KNN), is a promising lead-free ferroelectric material for multifunctional electronic applications. In the present study, $(1-x)K_{0.5}Na_{0.5}NbO_3$–$(x)SrFe_{12}O_{19}$ where x = (0, 0.3, 0.5, 0.7, 1) was fabricated by using the solid-state reaction method. The XRD study followed by Rietveld Refinement confirming the development of biphasic composites consisting of an orthorhombic $K_{0.5}Na_{0.5}NbO_3$ phase with (space group Amm2) and SFO showed a hexagonal crystal structure with (space group P63/mmc) without detectable impurity phases, confirming the structural compatibility of the ferroelectric and ferromagnetic constituents. The DC conductivity shows the semiconducting behavior of the material. The FESEM along with EDX put a glance on surface morphology and elemental composition of the synthesized samples. The composites showed lower-frequency dielectric dispersion due to polarization relaxation and

Maxwell–Wagner interfacial polarization. These results show a strong correlation between phase structure and electrical properties, highlighting KNN-based composites for energy-storage and multifunctional devices.

Keywords: X-ray diffraction (XRD), Multiferroics, Dielectric, Composite materials, Hexaferrite.

ICEMSET-2026/ST/1071

Structural and Optical Properties of YAG:Ce^{3+} Phosphor-in-Glass Composites Based on Eu^{3+}-Doped Lithium Bismuth Borate for White LEDs

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Abstract

YAG:Ce^{3+} phosphor in glass (PiG) composites were developed for white light-emitting diode (WLED) applications using Eu^{3+} doped lithium bismuth borate glass with the composition $(1-x)[0.1Eu_2O_3 \cdot 30LiF \cdot 10Bi_2O_3 \cdot 60B_2O_3]$ + xYAG:Ce^{3+},where (x = 0.15, 0.20, 0.25 and 0.30). The composites were synthesized through a melt quenching technique. XRD patterns confirmed the amorphous nature of the glass matrix along with characteristic diffraction peaks of crystalline YAG:Ce^{3+}, confirming successful incorporation of the phosphor. FTIR spectra revealed characteristic vibrational bands associated with BO_3, BO_4 and Bi–O structural units, indicating modification of the borate glass network. Under 464nm excitation, the PL spectra exhibited the characteristic yellow emission of Ce^{3+}, confirming efficient blue-light excitation and yellow-light conversion. UV–Visible analysis revealed optical band-gap values in the range of 3.3–3.4eV. The combined structural and optical properties demonstrate the potential of the developed PiG composites as efficient color converting materials for WLED applications.

Keywords: YAG:Ce^{3+}, PiG, Eu^{3+}, Yellow emission, WLED.

ICEMSET-2026/ST/1072

Thickness Optimization of an Interface-Engineered $FASnI_3$-Based Lead-Free Perovskite Solar Cell for Enhanced Photovoltaic Performance

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Abstract

Achieving high photovoltaic efficiency with reduced material consumption is essential for sustainable photovoltaic technology. Building upon our developed interface-engineered solar cell structure, Spiro-OMeTAD/$FASnI_3$/ZnO/FTO, this study investigates thickness optimization using SCAPS-1D. The thicknesses of $FASnI_3$, ZnO, andSpiro-OMeTAD were varied; their impact on photovoltaic performance was analyzed, and the optimum values were 0.80, 0.03, and 0.05 µm, respectively. The optimized device yielded a PCE of 25.45%, with a V_{oc} of 0.8275 V, Jsc of 42.30 mA cm^{-2}, and FF of 72.71 %. Significantly, the optimized Spiro-OMeTAD thickness of 0.05 µmrepresents a 75% reduction from the original thickness of 0.20 µm while maintaining excellent device performance. Further, the generation–recombination rate analysis was performed to examine the charge carrier generation and recombination behavior. These findings demonstrate the potential of thickness optimization for material-efficient and sustainable lead-free perovskite solar-cell design.

Keywords: Thickness optimization, $FASnI_3$, Recombination, Photovoltaic performance, SCAPS-1D.

ICEMSET-2026/ST/1073

Structural, Morphological, and Optical properties of co-doped TiO_2 thin films

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Abstract

Thin films of $Ti_{1-x-y}Zn_xCu_yO_2$ where (x =0.00, y=0.00) and (x=0.02, y=0.00, 0.04, 0.06,) studied in this work, were deposited on to Si (100) at room temperatures using a radio-frequency (RF) magnetron sputtering system. and investigated for their structural, optical, and morphological properties. X-ray diffraction (XRD) analysis confirmed the coexistence of anatase and rutile phases. Spectroscopy ellipsometry analysis revealed a significant decrease in optical band gap from 3.2 to 2.4 eV, which may be associated with changes in phase composition, crystallinity, and defect states. FESEM analysis showed changes in surface morphology and grain distribution of the deposited films. The observed correlation between structural, optical, and morphological properties demonstrates that the microstructure of TiO_2 thin films can effectively influence their optical band gap. These findings highlight the potential of mixed-phase TiO_2 thin films for optical and photocatalytic applications.

Keywords: TiO_2; RF magnetron sputtering; Crystallinity; Spectroscopic ellipsometry; Surface morphology.

ICEMSET-2026/ST/1074

Enhanced Humidity Sensing Performance of Chemically Dispersed MWCNT-TiO_2 Nanocomposite

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Abstract

Humidity sensing is essential for environmental monitoring, industrial process control, healthcare, and smart sensing applications. In this work, a MWCNT-TiO_2 nanocomposite was developed for humidity sensing using a simple chemical dispersion method. The incorporation of TiO_2 with multi-walled carbon nanotubes (MWCNTs) was employed to enhance the interaction of the sensing layer with water molecules and improve its humidity response. The fabricated sensor was evaluated over a relative humidity (RH) range of 11-84% RH at room temperature. The sensing characteristics were investigated by monitoring the variation in electrical current upon exposure to different humidity levels. The sensor exhibited a distinct and reproducible change in electrical response with increasing RH, demonstrating its ability to detect water vapour over a broad humidity range. The enhanced sensing behaviour of the MWCNT-TiO_2 composite is attributed to the synergistic interaction between the highly conductive MWCNT network and the hydrophilic TiO_2 surface, which promotes water adsorption and facilitates charge transport through the sensing layer. The results demonstrate that chemically dispersed MWCNT-TiO_2 is a promising sensing material for room-temperature humidity detection.

Keywords: TiO_2, Humidity, Chemiresistive.

ICEMSET-2026/ST/1075

Defect Engineering-Driven Enhancement of Thermoelectric Performance in $AgSbTe_2$ Thin Films

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Abstract

Defect engineering has emerged as an effective strategy for enhancing thermoelectric performance by tailoring carrier transport. In this work, controlled acidic etching was used to modify the defect structure and

thermoelectric properties of $AgSbTe_2$ thin films. $AgSbTe_2$ was synthesized via the melt–quench method, and thin films were deposited using thermal evaporation. Defects in films were introduced via acidic etching in a dilute HNO_3 solution for different etching durations, followed by thermal annealing at 363 K. Thermoelectric measurements at 303 K revealed a strong dependence of the transport properties on etching duration. Films etched for 5 min exhibited a maximum power factor (PF) of 1380.52 $\mu W\ m^{-1}\ K^{-2}$, corresponding to an enhancement of 165 % compared to without etched sample, along with a high Seebeck coefficient (S) of 220 $\mu V\ K^{-1}$. The highest electrical conductivity (σ) of 3.42×10^4 S m^{-1} was achieved for the sample etched for 1 min. Enhanced thermoelectric performance is attributed to defect-induced energy filtering and modified carrier scattering at defect-rich interfaces. UV–Vis spectroscopy indicated a gradual increase in the optical band gap with increasing etching duration, indicating the presence of quantum confinement effects. Structural and morphological analyses were performed using X-ray diffraction (XRD), field-emission scanning electron microscopy (FESEM), and atomic force microscopy (AFM) revealed enhanced porosity, cracks, increased defect density, and significant modifications in surface roughness after etching. These results demonstrate that controlled acidic etching provides an effective route for defect engineering and optimization of carrier transport, leading to enhanced thermoelectric performance in $AgSbTe_2$ thin films.

Keywords: Thin films, Seebeck coefficient, Power Factor, Pores.

ICEMSET-2026/ST/1076

First-principles study of LiCaCrSn quaternary Heusler alloy for thermoelectric applications

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Abstract

Quaternary Heusler alloys have emerged as promising materials for thermoelectric applications owing to their tunable electronic structures, high spin polarization, and favorable transport properties. In this study, we investigate the dynamical, electronic and thermoelectric properties of the quaternary Heusler alloy LiCaCrSn using first-principles density functional theory (DFT) calculations. Among the type-I, type-II, and type-III structural arrangements considered, the ferromagnetic type-III configuration is found to be the most stable. Lattice dynamical calculations confirmed that the alloy is dynamically stable. The studied alloy exhibits metallic behavior and shows promising thermoelectric performance with a good figure of merit. All the calculations were performed using the Elk code, which is based on the all-electron full-potential linearized augmented plane-wave (FPLAPW) method. The band structure calculated using the pseudopotential-based Quantum ESPRESSO code was subsequently used to compute the thermoelectric properties within the semi-classical Boltzmann transport formalism under the constant relaxation time approximation (CRTA), as implemented in the BoltzTraP code.

Keywords: Quaternary Heusler alloy, first-principles calculations, density functional theory, spin polarization, figure of merit.

ICEMSET-2026/ST/1077

Drift Shifts, Jitter Scatters: Deposition Tolerance in One-Dimensional Photonic Crystals

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Abstract

A one-dimensional photonic crystal is a multilayer coating whose practical limit is deposition error. Because uniform scaling moves its spectrum uniformly, fractional layer sensitivities sum to one. This separates a perfectly correlated common-mode error-a rigid shift calibratable when measured from independent jitter, whose residual scatter is reduced by $\sqrt{M_{eff}}$, the effective sampled-layer count. For the symmetric quarter-wave cavity studied, computed M_{eff} follows $4\bar{n}/\Delta n$ to 0.08% across a 44-fold contrast range, giving a parameter-free design rule. Two consequences follow once the mode is contained: adding layers cannot improve wavelength

accuracy and at equal independent fractional error variance, higher contrast increases scatter (Si/SiO_2 samples 4.9 layers versus 19.2 at low contrast). Transfer-matrix and Monte Carlo agrees within the expected finite-sample uncertainty.

Keywords: One-dimensional photonic crystal; Bragg reflector; fabrication tolerance; transfer matrix method; omnidirectional reflection.

ICEMSET-2026/ST/1078

Optimization of Hydrothermal Temperature for the Synthesis of Crystalline Anatase TiO_2 Nanoparticles with Enhanced Photocatalytic Activity

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Abstract

The present study investigates the role of hydrothermal temperature in controlling the formation and properties of TiO_2 nanoparticles synthesized from titanium tetra-iso-prop- oxide (TTIP). A citric acid assisted hydrothermal process was employed, with the reaction medium maintained at pH ~2.7 using 0.1 M citric acid. To examine the effect of thermal conditions, hydrothermal treatment was performed at 100, 120, 140, 160 and 200 °C. The resulting powders were systematically examined by X-ray diffraction (XRD), scanning electron microscopy (SEM), and Fourier transform infrared spectroscopy (FTIR), followed by evaluation of their photocatalytic behaviour. XRD measurements revealed the development of crystalline anatase TiO_2, with the characteristic diffraction maximum at ~25.3° corresponding to the (101) plane, while no significant rutile contribution was detected. A pronounced dependence of crystallite development on the hydrothermal temperature was observed. Notably, the material produced at 140 °C exhibited a crystallite size of about ~80 nm, which was lower than those obtained at the other investigated temperatures, indicating favourable control over crystal growth under this condition. SEM observations revealed temperature-associated changes in the particle morphology, whereas FTIR spectra supported the formation of Ti-O-Ti related bonding in the synthesized material. The photocatalytic experiments were performed to examine the influence of synthesis temperature on the photocatalytic performance of the TiO_2 nanoparticles. Overall, the results demonstrate that hydrothermal temperature is an important parameter for tailoring the crystallite size and morphology of TiO_2 nanoparticles, with 140 °C providing a favorable condition for obtaining relatively fine crystalline anatase TiO_2.

ICEMSET-2026/ST/1079

Wearable bio sensor for continuous monitoring of stress hormone

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Abstract

Stress-related disorders are increasingly associated with prolonged exposure to stress, creating a need for continuous and objective monitoring. This invention discloses a wearable biosensor system designed to continuously monitor stress hormone levels, particularly cortisol, from accessible body fluids such as sweat. The system integrates a flexible sensing electrode, hormone-sensitive biochemical recognition layer, signal-conditioning circuit, microcontroller, and wireless communication module in a compact wearable platform. The biosensor detects changes in cortisol concentration and converts them into measurable electrical signals. Real-time data are processed and transmitted to a smartphone or cloud-based application for visualization, trend analysis, and stress assessment. The system can provide timely alerts when hormone levels indicate elevated stress, supporting preventive intervention and remote health monitoring. This invention offers a non-invasive, portable, continuous, and cost-effective approach to personalized stress monitoring.

ICEMSET-2026/ST/1080

Visual Odometry for Smart Robotics: A Review of Techniques, Applications, and Challenges

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Abstract

As the technology has advanced through the years, the demand of the traditional robotic systems dependent on incessant human intervention has significantly dropped since a surging demand of modern robotic systems has been observed; these robotic systems can perform manipulation and navigation tasks on their own. The conventional or traditional robotic systems rely on fixed, programmed information leading to the cause of errors in case of environmental variations or uncertainties in various parameters such as actuator positioning, mechanical backlash or movement of objects, however, vision-based sensing robotic systems can provide a better approach to solve such problems as the robots can continuously monitor their environments on their own. This review paper focuses on the role of Visual Odometry (VO) in developing robotic systems that are intelligent. The basic concepts of the Visual Odometry, image acquisition, feature detection, feature tracking, optical flow, motion estimation and pose estimation are discussed in this review paper. Sparse optical-flow-based approaches such as Lucas Kanade method, monocular Visual Odometry and their suitability for low cost, resource-limited robotic platforms are given special attention. This paper also provides an outlook on the connection between Visual Odometry, Visual Servoing, and closed loop robotic control, which can therefore be concluded to show its use in correcting the robotic motion. The applications of such robotic systems using Visual Odometry, categorised under robotic navigation, object detection, manipulation tasks and pick-and-place tasks are also investigated in this review. All these applications can henceforth be integrated into a single robotic system making it more intelligent and autonomous. A few insurmountable challenges are also devised which include - scale ambiguity in monocular vision, changes in lighting, limited computing resources, loss of visual features, camera calibration, and the buildup of estimation errors. Lastly, the paper presents the working mechanism of a low cost Visual Odometry based robotic arm with a camera at its end-effector providing real-time input to the robotic arm which then monitors the visual information and move towards its target to do the intended operation. The main objective of this review paper is to comprehend the role of Visual Odometry to ascertain the design of affordable, adaptable, and autonomous robotic systems while also identifying various challenges that can come up in the real-world operation.

ICEMSET-2026/ST/1081

Ferroelectric Control of Spin Splitting and Spin Hall Conductivity in Two-Dimensional van der Waals Materials

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Abstarct

The coupling between ferroelectricity and spin-orbit interaction offers an effective approach for manipulating spin-dependent electronic and transport properties in two-dimensional materials. In this work, we investigate the polarization-dependent spin splitting and spin Hall response in two representative van der Waals systems, namely ZrX_2 (X = Cl, Br, I) bilayers and the GeSb/α-In_2Se_3 heterostructure, using first-principles calculations. First, in ZrX_2 bilayers, sliding-induced ferroelectricity couples with spin-orbit coupling to generate layer-dependent spin splitting and Berry curvature. The layer polarization and associated electronic structure can be reversibly modulated by switching the ferroelectric polarization, resulting in a tunable layer-polarized spin Hall effect. We further demonstrate that the spin Hall conductivity is strongly dependent on the polarization state and electronic structure. Subsequently, in the GeSb/α-In_2Se_3 heterostructure, ferroelectric switching of α-In_2Se_3 leads to a pronounced reconfiguration of the spin-split electronic states. The Rashba spin splitting is shifted between the conduction- and valence-band regions for opposite polarization states, accompanied by substantial changes in the spin Hall conductivity. These results demonstrate that ferroelectric polarization can serve as an effective control parameter for spin splitting, Berry curvature, and spin Hall transport in van der Waals

materials, providing a unified platform for exploring electrically tunable spin-dependent phenomena in two dimensions.

ICEMSET-2026/ST/1082

Autonomous AI-Powered Wearable System for Real-Time Threat Detection and Emergency Response in Women's Personal Safety

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Abstract

The rising rates of harassment and assaults against women highlight the clear limits of traditional safety tools like pepper spray or manual alarms, which fail if a user cannot react during a high-stress emergency. Wearable AI devices solve this by offering continuous, hands-free protection. Using integrated GPS, motion sensors, and audio analysis, these smart systems monitor the surrounding environment for signs of distress, such as sudden movement, loud noises, or physical restraint. When danger is detected, the device acts autonomously without requiring user input. It can instantly trigger loud alarms to deter attackers while simultaneously broadcasting real-time location data and emergency alerts to trusted contacts and local authorities. By combining automated threat detection with immediate response capabilities, wearable AI bridges the gap left by conventional safety gear, delivering a far more reliable and proactive personal security solution for women.

Keywords: Women's safety, Wearable technology, Artificial intelligence, Autonomous threat detection, Emergency response.

ICEMSET-2026/ST/1083

Recent Advances in Magnetically Assisted Rheological Finishing of Biomedical Materials through Microwave Sintering of Composite Magnetic Abrasives

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Abstract

The surface integrity of biomedical components plays a critical role in their functional performance, wear behaviour and long-term reliability. Magnetically assisted rheological finishing has emerged as a promising advanced finishing approach because the magnetically controlled abrasive medium can conform to complex geometries while producing highly refined surfaces. However, conventional finishing media generally rely on mechanically mixed magnetic and abrasive particles, which may suffer from poor abrasive retention, particle separation and reduced finishing efficiency. Recent research has therefore focused on composite magnetic abrasives in which ferromagnetic particles and hard abrasive phases are integrated into a single structure. Microwave sintering offers particular potential for producing such abrasives by promoting rapid heating and effective interparticle bonding while retaining suitable magnetic and rheological characteristics. Studies on microwave-sintered CIP-Al_2O_3 and EIP-Al_2O_3 composite magnetic abrasives have demonstrated improved abrasive retention, material removal capability and surface finishing performance in chemo-mechanical magnetorheological finishing (CMMRF) compared with simply mixed abrasives. Parallel developments in magnetic field-assisted and magnetorheological finishing of titanium alloys and other biomedical materials further demonstrate the capability of these processes to improve surface quality on complex and miniature components. This review examines recent developments in composite magnetic abrasive fabrication through microwave sintering and their relevance to the finishing of biomedical materials. Particular attention is given to abrasive composition, microstructural development, magnetic behaviour, finishing mechanisms and process parameters. The remaining challenges and future opportunities for developing application-specific microwave-sintered abrasives for advanced biomedical surface finishing are also discussed.

Keywords: CMMRF; Composite Magnetic Abrasives; Microwave Sintering; Biomedical Materials; Surface Finishing.

ICEMSET-2026/ST/1084

Role of Supercritical Fluid on Ultrafast Processing of Functional 2D Materials

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Abstract

Supercritical fluids (SCFs) offer a powerful platform for the ultrafast processing and controlled engineering of functional two-dimensional (2D) materials by combining liquid-like solvating ability with gas-like diffusivity and tunable physicochemical properties. This work explores the role of SCF-mediated processes in the rapid synthesis, etching, exfoliation, defect engineering, and heterostructure formation of MXenes and related 2D materials. The unique reaction environment of SCFs enables accelerated mass transport, enhanced precursor penetration, and controlled reaction kinetics, facilitating the formation of structurally engineered MXenes within significantly shortened processing times. SCF-assisted synthesis is further extended to construct MXene-based 2D/2D and ternary heterostructures with layered double hydroxides, metal sulfides, and oxygen-deficient metal oxides. The resulting materials exhibit tailored surface chemistry, abundant active sites, improved charge transport, and synergistic interfacial interactions, demonstrating their potential for electrochemical energy storage and electrocatalytic applications.

Keywords: Supercritical; fluid; 2D material; MXenes; heterostructure.

ICEMSET-2026/ST/1085

Elemental Analysis of Rice Grains Near Paper Mill Using EDXRF: A Case Study of Yamuna Nagar

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Abstract

Rice is a vital global staple, and ensuring its safety from heavy metal contamination is critical, especially in industrially active regions. This study examines the elemental composition of rice grains cultivated near a paper mill in Sarawan village, Yamuna Nagar, Haryana, using Energy Dispersive X-ray Fluorescence (EDXRF) spectroscopy — a rapid, non-destructive, and sensitive technique. Ten rice samples were collected along a linear transect at 30 m intervals, from 0 m to 270 m from the industrial boundary, to study spatial elemental variation. Analysis using Ag K X-ray excitation and a Si-PIN detector revealed the presence of Cobalt, Zinc, Gallium, Strontium, Zirconium, and Molybdenum, all showing progressively decreasing concentrations with increasing distance from the source. Zinc recorded the highest concentration (45 ± 2 mg/kg near the source, decreasing to 20 ± 1 mg/kg at 270 m). These findings indicate a distance-dependent influence of industrial emissions on nearby crops, highlighting the need for regular heavy metal monitoring in agricultural produce near industrial zones.

Keywords: EDXRF; Rice grains; Heavy metals; Industrial contamination; Food safety; paper mill.

ICEMSET-2026/ST/1086

Tribological Properties of Hybrid Natural Fiber and Filler Reinforced Composites for Engineering Applications

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Abstract

This study has investigated the effect of natural fiber and filler as reinforced in an epoxy polymer matrix (NFRP) on tribological properties. The powdered raw fibers were chemically treated with 3% NaOH for 24 hrs, and natural fiber 5 wt. %, 10 wt. % and 15 wt. % with 3 wt. % filler was blended in the epoxy matrix. Compared to pure epoxy composite, an improvement was observed in terms of wear loss and coefficient of friction. Further, the tribological study has shown a lesser frictional coefficient in hybrid NFRP than in pristine epoxy specimen. The findings will contribute to the development of low cost and sustainable composite materials for future electronic and engineering applications.

Keywords: Natural fibers, filler, Epoxy, Tribology, Polymer Composite.

ICEMSET-2026/ST/1087

Investigation of Ferrite–Bioactive Glass Nanomaterials for Magnetic Hyperthermia Applications

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Abstract

Bone is a self-healing tissue for minor defects, but for larger defects due to trauma, osteoporosis, tumour removal, infection, or thinning, bone treatment methods such as autografts and allografts are currently used, which suffer from donor-site morbidity, limited osteoinductivity, and a risk of infection. Consequently, Bioactive Glass (BG), recognised as one of the most promising biomaterials, exhibits remarkable osteoinductive properties and can form a bond with both hard and soft tissues via hydroxycarbonate apatite (HCA), making it a promising option. Additionally, it contributes significantly to regenerative medicine, serves as a drug carrier, and functions in biosensor applications.[1] Furthermore, Magnetic BGs (MBGs) are another group used to combat cancer; they form a magnetic phase in the glassy matrix, and an applied magnetic field can generate heat, thereby yielding a controlled local increase in temperature under the hyperthermia treatment mechanism.[2] In this work, Fe_3O_4 were incorporated into bioactive glass nanoparticles with a nominal composition of $60SiO_2$-$36CaO$-$4P_2O_5$ (mol%). Fe_3O_4 nanoparticles and bioactive nanoparticles are synthesised using the coprecipitation and the sol-gel method, respectively. Later, these Fe_3O_4 nanoparticles are integrated into the bioactive glass matrix at 4% and 6% wt to synthesise Magnetic Bioactive Glass (MBG) nanoparticles. The synthesised samples are characterised using XRD, FTIR, VSM, and AC induction heating studies. XRD analysis confirmed the formation of Fe_3O_4 nanoparticles and their presence in MBG samples. FTIR analysis identified the presence of the Fe-O bond in the MBG samples, which changes its transmission percentage with concentration. Magnetic analysis was performed using a VSM, which showed that the Fe_3O_4 nanoparticles exhibit superparamagnetic behaviour with a saturation magnetisation of 66.95 emu/g, and that as the wt% of Fe_3O_4 nanoparticles in the bioactive glass matrix increases, the saturation magnetisation also increases. The Specific Absorption Rate (SAR) values are obtained from AC induction heating studies. Studies have been conducted in three different fields, and all samples reached hyperthermic temperatures. These properties make this material suitable for hyperthermia applications.

Keywords: Bioactive glass nanoparticles, Hyperthermia, Specific absorption rate.

ICEMSET-2026/ST/1088

Exploring the Optical and Colloidal Properties of Soot- Derived Carbon Dots for Bioimaging

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Abstract

The present work aims to explore lamp soot as an abundant, low-cost and sustainable carbon source for the development of carbon dots (CDs), for fluorescent probe applications, with a comparative evaluation against CDs synthesised from citric acid and ethylenediamine. Lamp-soot-derived CDs were prepared via hydrothermal treatment, while the reference CDs were synthesized using hydrothermal and microwave-assisted methods. The soot-derived CDs showed a hydrodynamic diameter of 18 nm and a negative zeta potential, indicating good colloidal stability. They also exhibited a high quantum yield of 85.48%, blue emission, and an 8 ns fluorescence lifetime, with a tunable bandgap. These infer lamp soot as an excellent precursor for producing high-performance fluorescent carbon dots in large quantities through a simple synthesis route.

Keywords: Carbon Dots; Lamp Soot; Photoluminescence; Quantum Yield; Lifetime.

ICEMSET-2026/ST/1089

Nickel Sulfide and Potato-Peel-Derived Carbon Spheres Composite: A Green, Multi-Technique Approach to High-Performance Supercapacitor Electrodes

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Abstract

Rising demand for sustainable, low-cost energy storage has driven interest in combining transition metal sulfides with biowaste-derived carbon for supercapacitors. This study reports a nickel sulfide/potato-peel-derived carbon sphere composite (NiS/PPCS), synthesized via a simple, eco-friendly hydrothermal route valorising kitchen biowaste as a carbon precursor. NiS and carbon spheres were synthesized separately, then combined hydrothermally, and characterized using XRD, FESEM, FTIR, TGA, and XPS, with electrochemical performance evaluated via CV, GCD, and EIS in a three-electrode setup. XRD confirmed the rhombohedral β-NiS phase with amorphous carbon, while FESEM showed rod-like NiS nanostructures intercalated over micron-sized carbon spheres. The composite achieved a maximum specific capacitance of 2185 F/g at 0.2 A/g (versus 1424 F/g for pristine NiS), retained 95.01% capacitance after 20,000 cycles, and exhibited lower charge-transfer resistance (5.55 Ω vs. 39.26 Ω). These results establish NiS/PPCS as a high-performing, economical, and sustainable electrode material for next-generation green energy storage.

Keywords: Nickel sulfide; biowaste-derived carbon; green synthesis; supercapacitor; sustainable energy storage.

ICEMSET-2026/ST/1090

Comparative Study of TiAlN-Coated and Plasma-Nitrided TiAlN-Coated H13 Hot-Work Tool Steel

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Abstract

AISI H13 hot-work tool steel is the material of choice for die casting, forging, and extrusion applications; however, its service life is often limited by adhesive and abrasive wear, and thermal fatigue. Among the surface-

engineering approaches investigated to H13 tooling performance, TiAlN coatings deposited by Physical Vapor Deposition (PVD) and duplex plasma (ion) nitriding followed by TiAlN deposition have received considerable research attention. This review systematically snthesizes approximately two decades (2001-2025) of literature to comparatively assess these surface treatments in terms of tribological performance, including friction, wear rate and mechanisms, coating adhesion, high-temperature behaviour, and thermal-fatigue resistance, together with mechanical characteristics such as surface and case hardness, load-bearing capacity, interfacial adhesion, fracture and impact resistance, and corrosion behaviour. The reviewed literature indicates that the duplex plasma nitriding with TiAlN approach provides enhanced resistance to friction, wear, coating failure, and thermal fatigue compared with single layer TiAlN coating. This improvement is attributed to the hardened and mechanically graded substrate produced by nitriding, which provides enhanced load bearing support to the ceramic layer and mitigates substrate plastic deformation, thereby delaying crack initiation, propagation, and coating spallation. This work further compares TiAlN coated H13 with TiAlN coated tool steels, highlighting the importance of substrate selection according to service temperature, and toughness requirements. Finally, key research gaps are identified in nitriding process performance, advanced coating architectures, and data-driven surface-engineering design, providing directions for future research and industrial implementation.

Keywords: H13 tool steel; Plasma nitriding; TiAlN coating; Duplex surface treatment; Physical vapour deposition (PVD); Tribological properties; Wear resistance.

ICEMSET-2026/ST/1091

Tuning Carbonization Temperature and Activator Concentration of Paddy-Derived Activated Carbon for Enhanced Supercapacitor Performance

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Abstract

The growing energy demand and abundance of agricultural residues necessitate innovative technologies that can address energy-storage and waste-management challenges. Biomass valorization into functional carbon materials offers a sustainable route to energy storage while adding value to agricultural waste. In this work, paddy-biomass-derived biochar was prepared at 450 °C for 4 h and activated with KOH at varying concentrations (2.5 and 5 M) and temperatures (550–850 °C) to tailor its porous structure. The resulting activated carbons were systematically investigated using FTIR, XRD, SEM, and BET, while their electrochemical behavior was evaluated through CV, GCD and EIS. The characteristic CV and GCD profiles revealed predominantly EDLC behavior. The findings demonstrate that tuning KOH concentration and activation temperature tailors the textural properties and electrochemical response. This study provides a sustainable route for converting agricultural biomass into value-added electrode materials, highlighting its potential for energy-storage applications toward a greener future.

Keywords: Biomass, Activated carbon; Porosity; EDLC; Energy storage.

ICEMSET-2026/ST/1092

Sustainable Conversion of Kitchen Biowaste into Porous Activated-Carbon-Based Electrodes for Supercapacitor Applications: Waste to Energy Storage

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Abstract

Kitchen biowaste is a readily available biomass feedstock with considerable potential for conversion into porous carbon materials for sustainable energy-storage applications. In this work, fruit and vegetable peels obtained from kitchen biowaste were utilized for the preparation of carbonaceous material. The biowaste was processed and subjected to carbonization in a tube furnace at different pyrolysis temperatures (300-750°C) to obtain

biochar. The prepared biochar samples were further activated using 5 M KOH solution, followed by thermal activation at 700°C. The prepared activated carbon samples were characterized using FTIR, XRD, FE-SEM and BET analysis to examine their chemical properties, surface morphology, structural characteristics and porosity. Electrochemical performance was evaluated using cyclic voltammetry (CV), galvanostatic charge–discharge (GCD) and electrochemical impedance spectroscopy (EIS). The study aims to correlate carbonization conditions with material properties and electrochemical performance, providing a promising route for converting kitchen biowaste into useful carbon-based electrode materials for energy storage.

Keywords: Kitchen biowaste; Biochar; Activated carbon; Porosity; Supercapacitor.

ICEMSET-2026/ST/1093

Sodium Carboxymethyl Cellulose (CMC) and Poly(acrylamide) (PAM) Based Hydrogels for Antidepressant Drug Release Applications

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Abstract

In this study, a pH-responsive Sodium Carboxymethyl Cellulose/ Poly(acrylamide) (CMC/PAM) hydrogels were prepared through a chemical cross-linking technique. Aluminium sulphate was used as a cross-linking agent (CLA) and ammonium persulphate as an initiator. The hydrogel blends showed maximum swelling rate in a slightly basic buffer environment. The synthesized hydrogels were loaded with the nortriptyline antidepressant drug. The drug loaded hydrogels and hydrogels without drug were characterized by FTIR, XRD, SEM and DSC methods. The drug was loaded into different cross-linked CMC/PAM hydrogels and dried. The dried drug-loaded hydrogels were transferred into three different buffer solutions (pH 1.2, 6.8 and 7.4) for drug release studies. The drug release study was carried out, for up to 12 hours by UV-Visible spectroscopy. The analysis of drug release kinetics showed that the drug release occurred predominantly through anomalous (non-Fickian) transport involving both diffusion and polymer relaxation mechanisms. The highest drug release (90%) was observed at pH 7.4 with optimum cross-linking concentration of 20%.

Keywords: CMC/PAM hydrogels; Nortriptyline; Antidepressant drug; Drug delivery; pH responsive drug release.

ICEMSET-2026/ST/1094

Short-Term Wind Power Forecasting Using Machine Learning Model Comparison and Performance Analysis

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Abstract

Over the past few years, a number of nations have achieved their renewable energy goals with the main objective of encouraging sustainable, low-emission development. The generation of renewable energy, mostly from solar and wind power, which are more unpredictable and variable than traditional sources, must be taken into account in order to accomplish these goals through efficient changes to the planning, security, maintenance, and operation of power systems. We have suggested and contrasted two optimized robust regression machine learning techniques, Random Forest Regression (RF) and Gradient Boosting Regression (XGBoost), to increase the short-term forecasting accuracy of wind power generation for the Turkish wind farm in western Turkey based on historical wind speed and direction data. Furthermore, the impact of input variables like wind speed and direction on wind power production is examined. The results demonstrate the Gradient Boosting Regressor's improved predictive performance with an MAE value of 0.0163, MAPE 0.679, RMSE 0.0354 and R^2 0.952 for forecasting of wind power.

ICEMSET-2026/ST/1095

Investigation of Printability and Functional Performance of Flexible Polymer Substrates for Printed Electronics

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Abstract

A significant additive manufacturing technique for creating lightweight, flexible and conformable electronic devices on a variety of substrate materials is printed electronics. The interaction of the substrate surface, printing method and functional material has a significant impact on the performance of printed electrical devices. To produce consistent and dependable printed layers, flexible polymer substrates in particular necessitate careful consideration of surface energy, wettability, morphology, dimensional stability and mechanical behaviour. The printability and functional performance of particular flexible polymer substrates meant for printed electronic devices are examined in this study. Before functional materials are deposited using a digital printing process, the substrates are evaluated for surface wetting behaviour, surface morphology and mechanical flexibility. Print uniformity, feature definition, surface coverage, adhesion and resistance to mechanical deformation are all assessed for the final printed structures. The link between substrate surface properties and the integrity, creation and spreading of printed functional layers is specifically examined. In addition to identifying substrate features that facilitate consistent material deposition, the project seeks to determine how substrate variables affect print quality and functional reliability. It is anticipated that the work will offer practical recommendations for process optimization and substrate selection in digitally manufactured flexible devices. The promise of digital printing as a flexible and scalable production method for functional electronic devices on polymeric substrates is further highlighted.

Keywords: Printed electronics, flexible polymer substrates, digital printing, printability, surface energy, adhesion, functional layers, flexible electronics.

ICEMSET-2026/ST/1096

Fake Identity Documents Detection using Deep Learning

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Abstract

Identity document misuse can happen when the information or image on a document is changed using image editing methods. This project focuses on developing a PAN Card Fraud Detection System that identifies a PAN card image as REAL or FAKE. Since a suitable labeled dataset of PAN card images was not available for this study, a standard PAN card template was used to prepare a synthetic dataset. Different normal and manipulated versions of the template were created for training. Before classification, the input images are processed using OpenCV. The images are resized and adjusted to reduce differences in size, colour, brightness, and contrast. Q-Learning is used during the training process to choose suitable image augmentation operations for the training images. These processed images are then used to train a Convolutional Neural Network (CNN) for classifying PAN card images into REAL and FAKE classes. After training, the system accepts a PAN card image either through image upload or through a camera. The input is processed in the same way before it is given to the trained CNN model. The system then displays the predicted class, REAL or FAKE, along with its confidence value. The project is developed as a proof-of-concept to study the use of image standardization, adaptive augmentation, and CNN-based classification for PAN card fraud detection.

Keywords: PAN Card, Deepfake Detection, CNN, Q-Learning, Data Augmentation, Image Standardization, OpenCV, Synthetic Dataset.

ICEMSET-2026/ST/1097

Noise Results from Different Sources and Attenuation Methods

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Abstract

Three main problems must be resolved if the present and future generations are to survive: pollution, poverty, and population expansion. This is a gift from urbanization, industrialization, and modern existence. These days, it's not uncommon to hear individuals lamenting the excessive noise pollution in the city after they've just finished their grocery shopping. They often blame two-, three-, and four-wheelers as well as commercial vehicles for the increase in background noise pollution. Loud speakers can be heard seriously disturbing the general population with their noise during special events like holidays, weddings, birthday parties, etc. In a city like Bengaluru, where construction activities are common, some mechanical processes suggest that noise levels are too high. Noise levels from equipment like marble cutters and jack hammers are 34 dBA higher than industry standards. Because of piling and mixer operation, the level has slightly increased. For the purpose of monitoring noise levels, the primary contributing vehicle has been chosen as a baseline. Despite being a calm neighborhood, noise levels at hospitals and other places are reported at 66 dBA since pedestrians frequently use this region. The local area, which includes open traffic and riverbeds, has a decibel level of 46dBA to 109dBA, which is more than the recommended limit. The thatched leaves shed in the form of enclosures are the noise barriers that are now being provided in this study. Every barrier has advantages and disadvantages, but they all contribute to some degree of noise reduction. Adding noise barriers, such as thatched leaves, has been shown to lower noise by 7.5% to 16.7%. The data sets included more than 4500 measurements taken at different locations throughout multiple zones in a single day. To forecast noise and act as a tool for future forecasts, a new model for noise prediction conditions was developed using the entire data set.

Keywords: Noise, construction noise, noise pollution, noise control, noise attenuation.

ICEMSET-2026/ST/1098

Precatalyst Engineering to Access Highly Active V-Fe(O)OH for Oxygen Evolution Reaction

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Abstract

Prussian blue analogues (PBAs) have emerged as promising precatalyst for the generation of catalytically active metal (oxy)hydroxide [M(O)OH] phase during oxygen evolution reaction. However, their catalytic performance is often hindered by intrinsic electronic repulsion within M-N≡C-Fe coordination framework, which restricts the efficient charge redistribution and electrochemical activation. To address this challenge, we introduce a dual electron complementation strategy for the rational design of a vanadium-iron PBA (VOFe-NO) by incorporating $Na_2[Fe(CN)_5NO]$ as linker. The combined d–d and d–π* electronic interactions effectively enhance electronic delocalization, weaken orbital repulsion, and accelerate electrochemical reconstruction. Consequently, VOFe-NO undergoes rapid transformation into a highly active V-Fe(O)OH phase (AC-NO). The reconstructed catalyst exhibits outstanding OER activity, requiring only 1.42 V vs. RHE to achieve a current density of 100 mA cm^{-2}. In-situ X-ray absorption spectroscopy together with in-situ Raman spectroscopy revealed the potential dependent reconstruction from VOFe-NO to AC-NO. Furthermore, in-situ electrochemical impedance spectroscopy showed accelerated charge-transfer kinetics in AC-NO, while mechanistic analysis revealed a lattice oxygen-mediated mechanism involving proton-decoupled electron transfer process for OER. Additionally, AC-NO showed stability up to 60 h in three electrode system.

Keywords: Prussian blue analogue, Oxygen evolution reaction, Reconstruction, Spectroscopy, Metal (oxy)hydroxide.

ICEMSET-2026/ST/1099

Ni^{3+} or Ni^{4+}? Identifying the active sites for anodic oxidation reactions

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Abstract

Which oxidation state of Ni is truly responsible for anodic oxidation reactions-Ni(III) or Ni(IV)? Despite decades of research on nickel-based electrocatalysts, this fundamental question remains unresolved, particularly for emerging anodic oxidation reactions (AORs), where the nature of the catalytically active species remains elusive. Addressing this challenge is crucial for the rational design of highly efficient electrocatalysts. In our work, we identified the active sites for both the oxygen evolution reaction (OER) and the iodide oxidation reaction (IOR). By introducing benzoate into NiCo hydroxide (BZ-NiCo-H), the electronic and coordination environment of the catalyst was precisely tuned, promoting the formation of high-valent nickel species under anodic conditions. In-situ Raman spectroscopy and electrochemical studies reveal that Ni^{4+} in γ-Ni(O)OH is the active species for OER, whereas Ni^{3+} in β-Ni(O)OH is responsible for IOR, providing the first evidence for active-site identification in the IOR. These findings establish that the active species in electrocatalysts are reaction-dependent rather than universal, providing a new framework for the rational design of high-performance anodic electrocatalysts.

Keywords: Anodic oxidation reactions; Iodide oxidation reactions; Oxygen evolution reaction; In-situ Raman spectroscopy; Active species.

ICEMSET-2026/ST/1100

Bioinspired Proton Shuttle Strategy for Benzyl Alcohol Oxidation in Alkaline Seawater Anion Exchange Membrane Electrolyzer

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Abstract

Seawater oxygen evolution reaction (OER) suffers from sluggish kinetics and competitive chloride oxidation reaction (ClOR). In this context, replacing seawater OER with benzyl alcohol oxidation reaction (BAOR) has been an effective approach to improve overall energy efficiency and produce value-added chemicals. Herein, we have introduced terephthalic acid (TPA) as an organic linker into a NiCo-hydroxide system (TPA-NiCo-H), where TPA acts as a proton-shuttle centre during BAOR in seawater. Experimental and theoretical calculations confirm that the TPA ligand facilitates proton transfer by establishing a favorable hydrogen-bond network at the interface, thereby accelerating BAOR. This work highlighted that TPA acts as a proton-shuttle centre to enhance the OER and BAOR in seawater.

Keywords: AEM electrolyzer; Bioinspired proton shuttle; Interfacial hydrogen bonding; Seawater BAOR; Terephthalate introduction.

ICEMSET-2026/ST/1101

Development of chitosan/Carbon nanofiber –Melamine for Dye Adsorption and antibacterial application

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Abstract

Chitosan-CNF-Melamine aerogel was synthesised via a facile, eco-friendly method and characterised for its structural and morphological properties. FTIR and TGA analyses were used to identify the aerogels' chemical structure, and BET analysis was used to complement the characterisation of these materials. The resulting aerogel showed a three-dimensional skeletal structure that provides good porosity, acceptable swelling capacity, and good dimensional stability. The composite exhibits remarkable adsorption and a high potential for removing sunset yellow and tartrazine dye, attributed to its enhanced surface area, porous structure, and active functional groups. Antibacterial tests showed strong inhibition zones against E. coli and S. aureus.

ICEMSET-2026/ST/1102

Development and Characterization of Hazelnut Oil-Derived Biolubricant: Comparison with Conventional SAE 5W-30 Lubricant

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Abstract

The rising demand for sustainable lubricants has encouraged the development of vegetable-oil-based biolubricants. This study investigates hazelnut oil-based biolubricant (HOBL) and compares its physicochemical properties with SAE 5W-30 lubricant. Hazelnut oil was first converted to hazelnut oil methyl ester (HOME) through alkaline transesterification and subsequently reacted with trimethylolpropane (TMP) to produce HOBL. The purified product achieved a yield of 93.4%, with viscosities of 47.8 cSt at 40 °C and 9.3 cSt at 100 °C and a viscosity index of 178. Its flash point and acid value were 292 °C and 3.21 mg KOH/g, respectively. In comparison, SAE 20W-40 exhibited viscosities of 52.4 and 9.7 cSt, a viscosity index of 152, and a flash point of 228 °C. FTIR and GC–MS confirmed the chemical characteristics of HOBL. Overall, HOBL demonstrated comparable viscosity-temperature behavior and offers a renewable alternative to conventional lubricants.

Keywords: Biolubricant; Hazelnut Oil; Flash point; Acid Value.

ICEMSET-2026/ST/1103

In-silico Study of promising drugs Apricitabine, Lefitolimod and Amdoxovir: A comparative approach

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Abstract

In the present study, three drug candidates namely apricitabine, lefitolimod and amdoxovir, that have shown potential for treatment of cancer and viral infections including HIV and HBV, have been investigated using DFT based techniques. Molecular geometries of these drugs have been optimized with B3LYP/6-311+G(d,p) and ωB97XD/6-311+G(d,p) techniques. The optimized geometries of these molecules have further been utilized to investigate electro-optical, NLO, electronic and global reactivity descriptor parameters along with absorption spectra of these chosen drug molecules. The outcomes have been examined in accordance to the pharmacological, physico-chemical, and other technological applications of these compounds. Furthermore, this work highlights the significance of DFT-based approaches in drug discovery by providing atomistic-level insights and computational models that help bridge the disciplines of physics, chemistry, and biology.

Keywords: HIV- drug, DFT, HOMO-LUMO, UV-vis.

ICEMSET-2026/ST/1104

Facile synthesis of cellulose–supported–nickel–zinc–tungstate ternary composite for enhanced energy storage

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Abstract

Supercapacitors (SCs) are designed to offer high specific capacitance, long cycling stability and excellent power and energy densities, making them suitable for next generation energy storage systems. The mixed metal oxides have gained strong interest due to their multifunctional properties. In this work nickel-zinc-tungstate (NZWO) with cellulose (CL) show much higher electrical conductivity than the NZWO. The prepared material of NZWO was synthesized via hydrothermal method. The FESEM and TEM images reveal the sphere like morphology of NZWO-CL, whereas the XRD and XPS data further confirm its successful growth. The electrochemical performance was evaluated using CV, GCD, and EIS with a 3 M KOH electrolyte. Furthermore, the CV Plots indicate the pseudocapacitance behavior for all the samples, owing to the redox reactions. The synthesized nanocomposite provides improved electrode/electrolyte interfaces, which facilitate efficient ion diffusion. As the result, the NZWO-CL nanocomposite provides a high specific capacitance of 686.8 F/g at 1 A/g. The incorporation of CL enhances the development of abundant electrochemically active sites, resulting in improve capacitive performance. Furthermore, the NZWO-CL electrode was assembled into an asymmetric device, which showed magnificent energy and power densities values of 20.4 Wh/kg and 743.7 W/kg, respectively, preserving 96% capacitance after 6,000 cycles at 3 A/g. This study presents an effective strategy to enhance ion/charge transfer and adsorption in multi-transition metal architectures, advancing the development of SCs electrodes.

Keywords: Nickel–zinc–tungstate, Cellulose, Hydrothermal, Energy storage, Supercapacitor.

ICEMSET-2026/ST/1105

Foodbridge: An AI-Assisted Smart Platform for Food Donation and Redistribution

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Abstract

Food waste creates environmental, economic, and social problems, while surplus food is often not redistributed efficiently or on time. FoodBridge is an AI-assisted platform designed to improve food donation and redistribution by connecting donors, recipients, volunteers, farmers, and administrators through a single system. It supports donation management, food freshness assessment, volunteer assignment, route planning, priority handling, and real-time tracking. A ResNet50 model, trained using transfer learning from ImageNet, classifies food images as pure-fresh, medium-fresh, or rotten and provides class probabilities to support decisions, with final verification by authorized personnel. Location-based volunteer assignment and Google Maps routing help coordinate deliveries. A rule-based priority system considers expiry time, perishability, volunteer proximity, recipient demand, and traffic conditions. Tested on 1,800 images, the model achieved 95.6% accuracy, precision, recall, and F1-score, with a macro-ROC-AUC of 0.9689.

Keywords: Surplus Food Redistribution, Visual Freshness Assessment, ResNet50, Transfer Learning, Route Planning.

ICEMSET-2026/ST/1106

Performance Analysis of MWCNT-Core Coaxial Through-Silicon Vias with HfO2/BCB Dual-Dielectric Liners for Ultra-Low-Noise 3D IC Applications

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Abstract

This article presents a novel HfO_2 stands for hafnium oxide and BCB stands for benzocylobutene dual-dielectric liner for ultra-low-noise 3D IC applications. Traditional SiO_2 liners often require thicker layers for adequate bottom coverage, but excessive thickness can reduce the via opening and compromise structural reliability. To overcome these limitations, the proposed liner minimizes parasitic capacitance and substrate leakage while addressing the performance constraints of insulated interconnects at millimetre-wave frequencies. As TSV dimensions scale down, the increased aspect ratio and reduced critical dimension create significant challenges for conventional liner deposition. The transmission loss from 0.1 to 100 GHz reveals stable insertion loss of approximately −2.5 dB and return loss better than −11.9 dB. The linear phase response indicates negligible dispersion, ensuring strong signal integrity. These findings demonstrate that the proposed Core-MWCNT CTSV architecture provides a reliable paradigm for next-generation, high-speed, and noise-sensitive semiconductor systems in the 100 GHz.

Keywords: Core-MWCNT (C-CTSV), Dual dielectric HfO2/BCB, 3D ICs.

ICEMSET-2026/ST/1107

Exploring Power–Delay Trade-offs in Half-Adder Architectures Through Transistor Width Optimization

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Abstract

The continuous scaling of CMOS compatible devices has led to advancement as well as emergence of various problems such as power efficiency, leakage and device performance. These factors have become a critical challenge in VLSI circuit design. The Half Adder acting as building block of arithmetic units, plays a significant role in determining the overall computational efficiency and being the bottle neck for performance parameters. Our work takes on this fundamenatal adder circuit which we have designed using Cadence suite with CMOS, pass transistor, and transmission gates. A comparative approach in adder designing at transistor-level is presented with performance parameters such as leakage current, power dissipation, and propagation delay, under various transistor width sizing configurations. We demonstrated the optimum transistor sizing for efficient power and leakage usage, indicating that specific transistor sizes can significantly influences leakage behaviour and power characteristics while maintaining relatively stable delay performance. This gives valuable insight for physical designer to re-duce the power-delay-product, offering an empirical framework for designing power efficient arithmetic circuits at scaled nodes for future generations.

Keywords: CMOS Adder, scaling, Transistor Sizing, Leakage Power, Power Dissipation, Propaga-tion Delay, Cadence suite.

ICEMSET-2026/ST/1108

First-Principles DFT Benchmarking of Nanomaterials vs. Conventional Gate Stacks for ISFET Based Biosensors

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Abstract

This study presents a first-principles density functional theory (DFT) benchmarking of five nanomaterials—graphene, ZnO, TiO_2, Al_2O_3, and thiol-functionalized Au nanoparticles—against conventional Si, SiO_2, and Si_3N_4 materials for ISFET-based biosensors. Calculations were performed using Quantum ESPRESSO with GGA-PBE, including DFT+U corrections for ZnO and TiO_2. Ground-state energies, Fermi levels, band structures, and density of states were evaluated to establish material-level electronic characteristics. The benchmarking indicates that graphene provides substantially higher carrier mobility than silicon, while TiO_2 offers a markedly higher dielectric constant than SiO_2. ZnO provides near-Nernstian pH sensitivity, and Au–SH provides a stable surface chemistry for enzyme immobilization. The results demonstrate the potential of nanomaterial-based gate stacks for improving ISFET biosensor performance and provide computational guidance for future TCAD validation and experimental fabrication.

Keywords: ISFET biosensor; DFT; nanomaterials; Quantum ESPRESSO; gate dielectric.

ICEMSET-2026/ST/1109

Tailoring of Nanocomposites of Metal Oxide Ferrite Synthesized via Ultrasonication and their Characterization

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Abstract

Magnetic metal oxide ferrites have garnered significant interest due to their tunable electronic properties and applications in data storage, catalysis, and biomedicine. However, the performance of these ferrites is highly dependent on particle size, crystallinity, and cation distribution. This study reports the synthesis of metal oxide ferrite nanocomposites using a high-intensity Ultrasonication, designed to produce fine, non-agglomerated powders with narrow size distributions. The present synthesis process involved the irradiation of precursor solutions with ultrasonic waves, leading to the formation, growth, and collapse of acoustic cavities. Ultrasonication significantly reduced the reaction time and eliminated the need for prolonged high-temperature calcination, thereby preventing excessive grain growth. Characterization of the synthesized ferrites was conducted to correlate the sonochemical parameters with material performance. X-ray Diffraction (XRD) confirmed the formation of the single-phase spinel structure, with Rietveld refinement indicating the influence of Ultrasonication on cation site occupancy. Vibrating Sample Magnetometer (VSM) was employed to measure saturation magnetization and coercivity, revealing a transition toward superparamagnetic behavior as particle size decreased under controlled Ultrasonication power. Morphological behavior was determined by Transmission Electron Microscopy (TEM) and Energy Dispersive X-ray (EDX) analysis verified the highly crystalline nature of the ferrites and the stoichiometric uniformity of the metal oxides within the composite. Brunauer-Emmett-Teller (BET) analysis demonstrated an increased specific surface area, enhancing the potential for catalytic and adsorptive applications. The findings suggest that Ultrasonication is a superior alternative to traditional co-precipitation or hydrothermal routes, offering precise control over the magneto-structural properties of metal oxide ferrite nanocomposites.

Keywords: Metal oxide ferrites, ultrasonication, sonochemical, spinel structure, Rietveld refinement, magnetic Properties, Transmission electron microscopy, Superparamagnetism etc.

ICEMSET-2026/ST/1110

GrocerVox Unit-Aware Voice Billing with Smart Product Matching

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Abstract

Voice billing can be helpful in small grocery shops as it allows the shopkeeper to add products without typing them one by one. In voice input, the same product can be mentioned in different ways, and the quantity can also be given in different units such as kg, g, litre, and ml. Because of this, identifying the right product and calculating its price can become difficult. GrocerVox is developed as a multilingual voice-based grocery billing system to handle these issues. It uses product classification along with unit-based price calculation. For identifying the product, the corrected text is processed using a Self-Organizing Map (SOM) followed by Learning Vector Quantization (LVQ) for product classification. A Temporal Convolutional Network (TCN) is used to extract the quantity and unit from the corrected billing command. The normalized quantity and unit are then given to a Neural Arithmetic Logic Unit (NALU) for price calculation. Before generating the bill, a symbolic checking layer verifies whether the selected unit is suitable for the unit used in the product price. For example, if tomato costs 60 rupees per kg, the system converts 500 g into 0.5 kg and calculates the bill amount as 30 rupees. The performance of GrocerVox is evaluated using product classification accuracy, F1-score for quantity and unit extraction, price calculation accuracy, unit verification accuracy, and processing time. The system is intended to reduce errors in product selection and quantity-based billing in multilingual grocery transactions.

ICEMSET-2026/ST/1111

Structural Evolution and Lattice Strain in Gd- and Tb-Doped ZnO Nanoparticles: Insights into Rare-Earth-Induced Modifications

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Abstract

Rare-earth (RE) doping provides an effective approach for tailoring the structural and functional properties of ZnO nanoparticles. In the present study, the influence of Terbium (Tb) and Gadolinium (Gd) incorporation on the crystal structure, lattice strain, crystallite size, morphology, and surface defects of ZnO nanoparticles is investigated. X-ray diffraction (XRD) analysis confirms that all the synthesized samples retain the hexagonal wurtzite structure of ZnO without the formation of detectable secondary phases. The incorporation of Tb and Gd results in dopant-dependent changes in crystallite size and lattice parameters, accompanied by variations in microstrain. The smaller ionic radii of the RE dopants relative to Zn^{2+} contribute to lattice distortion and contraction, while their electronic configurations influence defect formation and surface characteristics. A comparative analysis of Tb- and Gd-doped ZnO demonstrates the important role of dopant identity in controlling the structural characteristics of ZnO nanoparticles. The observed relationship between RE incorporation, lattice strain, defect formation, and surface chemistry provide useful insights into the controlled modification of ZnO nanoparticles. These findings are particularly relevant for developing RE-doped ZnO materials with tailored optical and structural properties for potential phosphor and optoelectronic applications.

Keywords: Strain, RE doping, ZnO nanoparticles, Structural properties, defect states.

ICEMSET-2026/ST/1112

Anisotropic Magnetic Behavior of the Chiral Helimagnet $Cr_{1/3}NbS_2$

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Abstract

The study of magnetic anisotropy in two-dimensional chiral magnetic materials is important for understanding their fundamental magnetic behavior and potential applications in spintronic devices. Chromium-intercalated niobium disulfide ($Cr_{1/3}NbS_2$) is a chiral helimagnetic material that exhibits non-collinear magnetism arising from its non-centrosymmetric crystal structure and competing magnetic interactions. In this study, we examine the magnetic behavior of $Cr_{1/3}NbS_2$ through temperature-dependent and magnetic field-dependent magnetization measurements, with the magnetic field applied both in and out of the plane of the material. The comparative analysis of the magnetization curves reveals a pronounced directional dependence of the magnetic response, demonstrating the highly anisotropic nature of the $Cr_{1/3}NbS_2$. The differences in the magnetization for both field orientations highlight the role of magnetic anisotropy and competition between the magnetic interactions. This study contributes to a better understanding of the anisotropic nature of $Cr_{1/3}NbS_2$ and its relevance to chiral magnetism and potential spintronic applications.

Keywords: Magnetic anisotropy, chiral helimagnet, non-collinear magnetism, spintronics.

ICEMSET-2026/ST/1113

Prediction of Insulin Bolus Dosage in Diabetic Patients Using Ontology Mapping and Deep Learning Models

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Abstract

Accurate insulin dosage prediction is essential for effective management of Type 1 diabetes, as insulin requirements vary according to glucose levels, meals, physical activity, and physiological conditions. This study presents a completed deep learning framework for insulin bolus dosage prediction using ontology mapping and graph-based learning. The OhioT1DM dataset was utilized, containing longitudinal glucose, insulin, meal, exercise, physiological, and lifestyle information from Type 1 diabetic patients. The data were preprocessed and transformed into structured temporal representations. An ontology was developed to represent relationships among relevant diabetic health factors, and a knowledge graph was constructed for graph-based learning. LSTM, GRU, and BiLSTM models were implemented to capture temporal dependencies, while a Graph Convolutional Network (GCN) was integrated to learn relationships among interconnected health factors. The implemented framework successfully combines temporal and relational information to predict insulin bolus dosage from multiple patient-related factors.

Keywords: Insulin Bolus Dosage; Diabetes; Ontology Mapping; Knowledge Graph; Deep Learning.

ICEMSET-2026/ST/1114

Impact of micelles in the bi-phasic oxidation of DL-2-Amino-3-hydroxybutanoic acid: Comprehensive kinetic and mechanistic insight

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Abstract

In continuation of our work on the kinetic studies in the oxidation of biologically, pharmaceutically, environmentally and industrially important organic substrates, in the present work we have extended our focus on DL-2-Amino-3-hydroxybutanoic acid (AHA) by Ce(IV) in micellar medium. The study bears importance as AHA, an amino acid present in central nervous system is important for metabolic reactions. Moreover, redox processes in micellar media mimic biological processes and hence are considered significant. Micelles are organized assembly of surfactant monomers formed at a concentration regarded as critical micelle concentration (cmc). Progress of the reaction was monitored using a UV-VIS spectrophotometer maintaining pseudo first

order conditions. Unit order dependence of rate on oxidant concentration was indicated by the linearity of plots between log (Absorbance) vs time. Detailed kinetic analysis revealed unit order dependence of rate on [AHA] and almost second order dependence on acid strength. Effect of other parameters like added salt and Ce(III) on the oxidation was also undertaken as a part of the study. In the micellar media although the main kinetic features remained somewhat similar compared to pure aqueous medium but presented some interesting results which calls for an explanation. We have considered Berezin model (Scheme) to explain our findings.

Keywords: Micelle, Kinetics, Surfactant, Redox, Berezin model.

ICEMSET-2026/ST/1115

Probability-Guided Signal Reconstruction for RIS-Assisted Wireless Communication Using CNN-Based Spectrum Sensing

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Abstract

This work presents a probability-guided signal reconstruction framework for reconfigurable intelligent surface (RIS)-assisted millimeter-wave communications. A 28-GHz QPSK system aided by a 64-element passive 1-bit RIS is evaluated under practical channel impairments including Rician fading, carrier frequency offset, Doppler shifts, and phase noise. Rather than applying hard thresholding, a convolutional neural network (CNN) performs spectrum sensing on received I/Q frames to estimate continuous signal-presence probability. This probability controls an adaptive bounded gate that feeds a reconstruction CNN to recover clean I/Q baseband waveforms. Evaluated over 42,000 frames from -20 to +20 dB SNR, the sensing stage achieves 91.08% accuracy and 0.9509 AUC. The proposed probability-guided CNN reduces normalized mean squared error from 26.5010 to 0.4165, EVM from 514.79% to 64.54%, and BER from 0.1939 to 0.1488, outperforming unguided baselines and demonstrating the efficacy of probability-guided physical-layer waveform recovery.

Keywords: Reconfigurable Intelligent Surface (RIS); Millimeter-Wave; Spectrum Sensing; Convolutional Neural Network; Signal Reconstruction.

ICEMSET-2026/ST/1116

Investigation on the Structural Performance of Sustainable Concrete Structure With L-Section and T-Section Beams by Finite Element Modelling

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Abstract

The present investigation offers a numerical analysis of the bending performance of reinforced concrete L-beam and T-beam configurations under a central point load and a uniformly distributed load (UDL) utilizing the finite element method. Both beam models were developed using identical material and reinforcement properties. Key response parameters like equivalent plastic strain, elastic strain, reinforcement von Mises stress, principal tensile stress in concrete, and vertical deformation were analyzed. Results show that the L-beam exhibited early cracking, higher plastic strain accumulation, larger reinforcement stress, and greater mid-span deflection, particularly under UDL, indicating reduced stiffness and structural efficiency. The T-beam demonstrated delayed crack initiation, lower reinforcement stress levels, reduced deformation, and superior stiffness under both loading conditions, attributed to its wider compression flange and higher moment of inertia. Overall, the findings confirm that beam geometry plays a critical role in static flexural behaviour. The T-beam demonstrated superior structural efficacy, providing greater load-bearing capacity, better fracture management, and increased serviceability compared to the L-beam. These outcomes underscore the benefits of T-beam configurations in reinforced concrete engineering, particularly for scenarios experiencing substantial bending forces.

Keywords: Finite Element Method (FEM), Flange Beams Plastic Strain, Elastic Strain, Principal Stress, Vertical Deflection.

ICEMSET-2026/ST/1117

Self-Healing Concrete for a Sustainable Marine Environment: Bio-Chemical Microcapsules and Nano-TiO_2 for Crack Repair and CO_2 Sequestration

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Abstract

Concrete cracks allow pores, water, and chlorides to enter, which shortens the service life of reinforcement and causes corrosion under the marine structures. In this study, Bacillus subtilis spores are enclosed in silica-based microcapsules with nano-TiO_2 in the outer shell, and microencapsulated biochemical healing agents are mixed with photocatalytic nano-TiO_2 to create a self-healing M40 concrete as per IS 456:2000. The spores become active and capsule breaks to produce calcium carbonate (CaCO3) by Microbially Induced Calcite Precipitation (MICP), the bacteria get filled in cracks and automatically closes the gaps. Additionally, when exposed to light, nano-TiO_2 breaks down pollutants including NOx and VOCs and absorbs CO_2 to aid in CO_2 sequestration. The study will assess sorptivity, water absorption, acid and chloride resistance, crack-healing effectiveness, compressive strength recovery, physical and mechanical properties under the sea water condition. The suggested concrete is anticipated to contribute to sustainable green buildings by lowering the environmental impact of construction, extending structural life, and requiring less repair and maintenance for marine environment.

Keywords: M40 concrete, Bacillus subtilis, nano-TiO_2, MICP, CO_2 sequestration, self-healing concrete under marine environment.

ICEMSET-2026/ST/1118

Eu^{3+}-induced defect engineering in $Ag_8W_4O_{16}$ for enhanced pseudocapacitive energy storage

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Abstract

The development of rare-earth-modified transition-metal oxides with tailored charge-transport characteristics is critical for advancing high-performance electrochemical energy-storage systems. In this study, Eu^{3+}-doped $Ag_8W_4O_{16}$ nanomaterials were synthesized via a hydrothermal route to systematically elucidate the influence of Eu^{3+} incorporation on their structural, morphological, optical, and electrochemical properties. Comprehensive structural and spectroscopic investigations confirmed the formation of orthorhombic $Ag_8W_4O_{16}$ with successful Eu^{3+} incorporation and modulation of the local Ag–O–W coordination environment. Eu^{3+} doping induced appreciable changes in crystallinity, defect chemistry, surface morphology, and charge-transfer characteristics, thereby facilitating improved ion diffusion and interfacial redox kinetics. Electrochemical analyses revealed a synergistic contribution of diffusion-controlled faradaic reactions and surface-controlled capacitive processes. The optimized Eu^{3+}-doped electrode exhibited enhanced specific capacitance, rate capability, and long-term cycling stability compared with pristine $Ag_8W_4O_{16}$. These findings highlight Eu^{3+}-induced defect engineering as an effective strategy for tailoring $Ag_8W_4O_{16}$ toward advanced energy-storage applications.

Keywords: Eu^{3+} doped $Ag_8W_4O_{16}$; Defect engineering; Pseudocapacitance; Charge-storage kinetics; Electrochemical energy storage.

ICEMSET-2026/ST/119

Synthesis and Biological Evaluation of Metal Complexes Based on New N'-(4-methoxybenzylidene)-2-phenoxyacetohydrazide Schiff Base

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Abstract

A new Schiff base ligand, N'-(4-methoxybenzylidene)-2-phenoxyacetohydrazide, was synthesized by condensing 2-phenoxyacetohydrazide with 4-methoxybenzaldehyde. The ligand and its Cu (II), Mn (II), Ni (II), and Zn (II) complexes were prepared and characterized using elemental analysis, FT-IR, UV–Vis, and magnetic studies. Spectral data confirmed that the ligand acts as a bidentate donor, coordinating through the azomethine nitrogen and carbonyl oxygen atoms. The synthesized compounds were evaluated for their antimicrobial, antifungal, and antioxidant activities. Results showed that the metal complexes exhibited enhanced biological activity compared to the free ligand.

Keywords: Schiff base, metal complexes, antimicrobial, antifungal, antioxidant.

ICEMSET-2026/ST/1120

Estimation of Natural radionuclides in the soil samples of the Kumaun Himalaya Region of Uttarakhand, India

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Abstract

This study presents a comprehensive investigation of primordial radionuclide concentrations in soils from the Ramnagar and Kashipur region of the Kumaun Himalaya in Uttarakhand. A random sampling framework was adopted to cover the maximum area and the activity concentrations of radium (^{226}Ra), thorium (^{232}Th), and potassium (^{40}K) were determined using NaI (Tl) gamma-ray spectrometry. The observed activity concentrations varied between 21.10 ± 4.46 to 56.80 ± 7.82 Bq kg^{-1} (arithmetic mean = 28.57 Bq kg^{-1}),29.20 ± 4.59 to 86.90 ± 10.1 Bq kg^{-1} (arithmetic mean = 41.86 Bq kg^{-1}) and 169.00 ± 90.7 to 701.00 ± 145 Bq kg^{-1} (arithmetic mean = 310.07 Bq kg^{-1}) respectively. The spatial variability of these radionuclides was subsequently examined, and radiological hazard parameters were evaluated to establish the baseline radiation status and assess the potential health implications of natural radioactivity in the study region.

Keywords: Radionuclide, Kumaun Himalaya, Gamma-ray spectrometer, Health Risk.

ICEMSET-2026/ST/1121

Resin for a Better Brew: Sustainable Caffeine Reduction in Tea and Coffee

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Abstract

From the beginning of our morning to the end of our day caffeinated beverages are considered as the most widely consumed drinks worldwide and have become an integral part of daily dietary habits. Caffeine is the principal psychoactive compound present in these beverages, is mainly responsible for enhancing alertness and reducing fatigue. Moderate amount of caffeine consumption provides beneficial effects, including improved cognitive performance, neuromuscular coordination etc. However, excessive intake of caffeine has been associated with adverse effects such as insomnia, anxiety and cardiovascular complications which create

demand for safe and affordable decaffeinated beverages most commonly tea and coffee. The present study focuses on the development of a sustainable natural resin-based material for effective caffeine reduction from tea and coffee. The material was also further evaluated for its reusability to minimize material consumption, process waste and environmental impact. Present conventional solvent and water-based methods for decaffeination are effective though but may involve limitations related to solvent toxicity, high water and energy requirements, flavor degradation and processing costs. Therefore, the proposed natural resin-based approach aims to provide a cost-effective, sustainable and scalable alternative for caffeine reduction.

Keywords: Caffeine, Decaffeination, Sustainability, Natural material, cost-effective.

ICEMSET-2026/ST/1122

Thermal & Microstructural Properties of Organic Sheet Materials Used Commercially in Corrugated Packaging

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Abstract

In this article, conventional sheets of organic materials are used to manufacture corrugated boxes. Fluted sheets using 3mm, 5mm, and 7mm organic material sheets are manufactured. Glued together they are raw materials for box manufacture Manufacturing was carried out on the semi-automatic single facer 52" corrugated machine industrial training set up. Roughness indices of the glued sheets increase with base material thickness. A relation between RMS values signifying roughness and tensile strength is observed. GLCM contrast values of SEM images of the organic sheets also support these results. Diffusivity of the sheets showcases a nonlinear increase with thermal conductivity. With the decrease in radii of the organic sheets, heat loss increases. The thermal conductivity range of the 100 GSM sheet was observed to be the largest among the different materials tested. This work enables the characterization of sustainable organic packaging materials while post-harvest livelihood skill-based training in packaging is imparted.

Keywords: Corrugated, thermal, conductivity, roughness, strength.

ICEMSET-2026/ST/1123

Layered Double Hydroxide-Based Nanocomposite Electrochemical Sensor for Sensitive Detection of Mycotoxin

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Abstract

Mycotoxins are toxic fungal metabolites that commonly contaminate cereals, coffee, wine, nuts, and spices, posing serious risks to human and animal health. Conventional detection methods such as HPLC and ELISA are accurate but costly, time-consuming, and unsuitable for on-site use, creating a need for simple, rapid, and field-deployable sensors. Here, we report a layered double hydroxide (LDH)-based nanocomposite as an electrochemical sensing platform for mycotoxin detection. The LDH nanosheets were synthesized by co-precipitation, offering a high surface area and abundant active sites, while the incorporated conductive nanoparticles enhance electron transfer. The formation of the nanocomposite was confirmed by XRD and FTIR, and its morphology was examined by SEM and TEM. Electrochemical performance will be evaluated using CV, DPV, and EIS. The sensor is expected to show a linear range of 0.1-100 ng mL^{-1} with a detection limit of about

0.05 ng mL^{-1}, along with high selectivity, reproducibility, and stability. This low-cost, portable, and sensitive platform offers a promising approach for on-site mycotoxin monitoring and food safety assurance.

Keywords: LDH-based nanocomposite; mycotoxin; electrochemical sensor; nanocomposite; mycotoxin detection; food.

ICEMSET-2026/ST/1124

Advances in Nanomaterial-Based Electrochemical Sensing of Selenium: Mechanisms, Performance, and Emerging Challenges

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Abstract

Selenium (Se) is an essential micronutrient with a narrow window between nutritional requirement and toxicity, demanding reliable determination in environmental, food, and clinical matrices. Although ICP-MS and AAS offer high sensitivity, their cost, infrastructure demands, and limited field applicability restrict routine on-site monitoring. This study critically evaluates nanomaterial-modified electrochemical platforms for Se determination, integrating material design, sensing mechanisms, analytical performance, and real-sample applicability. Reported sensors were benchmarked against seven criteria: limit of detection, linear range, recovery, reproducibility, recyclability, interference tolerance, and real-sample performance. Au nanoparticles, Au nanodendrites, Ag-based electrodes, and HPHM/graphite-modified electrodes showed notable performance. Most systems target Se(IV) via preconcentration, reduction, deposition, and stripping, whereas direct, selective Se(VI) detection remains underdeveloped. Electrode passivation, matrix interference, fabrication variability, limited regeneration, and insufficient validation in complex matrices persist as key barriers. Future work should prioritize speciation-resolved detection, multifunctional nanocomposites, standardized benchmarking, and portable electrochemical integration for field-deployable selenium monitoring.

Keywords: Electrochemical Detection; Selenium; Performance metrics; Metal and carbon nanostructures.

ICEMSET-2026/ST/1125

Exploring the Electrochemical Performance of Si_9C_{15} Siligraphene for Li-ion Secondary Battery Applications

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Abstract

Energy storage technologies are essential for overcoming the intermittency of sustainable energy technologies, and Li-ion secondary batteries predominate due to their excellent electrochemical per formance. However, increasing energy demands require the evolution of advanced high-performance anode material. Carbon-silicon based systems are particularly attractive because the stable car bon framework can mitigate the drastic structural expansion associated with silicon, while silicon enhances the Li storage capacity of carbon. Motivated by these complementary advantages, the recently synthesized Si_9C_{15} siligraphene monolayer has been explored for its suitability as an anode material for Li-ion secondary batteries with the help of density functional theory calculations. The monolayer exhibits good structural stability and intrinsic semiconducting behavior with a band gap of 1.8 eV, which gradually transforms into metallic character upon Li adsorption, indicating en hanced electronic conductivity. Strong Li adsorption is observed with an adsorption energy of -0.73 eV, and the system delivers a high theoretical storage capacity of 1240.78 mAh/g. The calculated Li diffusion barriers (0.30-0.58 eV) and the average operating voltage of 0.88 V indicate favorable ion transport kinetics and safe

electrochemical operation. Furthermore, ab initio molecular dynamics, mean square displacement, and radial distribution function analyses demonstrate excellent thermal stability, stable Li adsorption, suppressed Li clustering, and apprecia ble Li-ion diffusivity. These findings highlight Si_9C_{15} siligraphene as a promising high-performance anode candidate for next-generation Li-ion batteries.

Keywords: Si/C Monolayer, Next-Generation Li-ion Batteries, Non-Covalent Interactions, Open Circuit Voltage, AIMD.

ICEMSET-2026/ST/1126

Comparative Performance Analysis of $FAPbI_3$ and $MASnBr_3$ Perovskite-Based Solar Cells Using SCAPS-1D

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Abstract

In this work, a perovskite solar cell with the $ZnO/FAPbI_3/V_2O_5$ and $ZnO/MASnBr_3/V_2O_5$ structure was studied through numerical simulation. $FAPbI_3$ and $MASnBr_3$ was considered as the main absorber layers, whereas ZnO and V_2O_5 were used as the electron and hole transport layers, respectively. $MASnBr_3$ was introduced to improve charge transfer at the interface and support efficient carrier extraction. $MASnBr_3$ was considered as a lead-free, tin-based perovskite material and was reported as a less toxic alternative to conventional lead-based perovskites. The effects of layer thickness and defect density were investigated to obtain optimised device parameters. The results showed that proper adjustment of the individual layers improved carrier transport and reduced recombination losses. Optimised device performance parameters were obtained in terms of open-circuit voltage (Voc) was 1.01V, short-circuit current density (Jsc) was 34.01 mA/cm^2, fill factor (FF) was 81.74% , and power conversion efficiency (PCE) was 27.95%.

Keywords: FAPbI3, MASnBr3, Perovskite, SCAPS-1D, Efficiency.

ICEMSET-2026/ST/1127

Green-Synthesized ZnO-Based Functional Nanomaterials: Effect of Ag Incorporation on Physicochemical Properties and Antibacterial Performance

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Abstract

The development of sustainable nanomaterials through plant-mediated synthesis offers an environmentally compatible approach for obtaining functional materials. In the present study, ZnO (ZT) and Ag-doped ZnO (AT) nanoparticles were synthesized using *Curcuma longa* leaf extract as a natural source of bioactive compounds involved in nanoparticle formation and stabilization. The synthesized nanomaterials were characterized using complementary techniques to evaluate their optical, structural, morphological, and surface properties. UV–visible spectroscopy demonstrated characteristic ZnO absorption with a shift following Ag incorporation. X-ray diffraction confirmed the crystalline hexagonal wurtzite structure of ZnO, with additional Ag-associated reflections in AT. FTIR analysis indicated the involvement of plant-derived functional groups in nanoparticle stabilization, while electron microscopy revealed finer and more uniformly distributed particles in AT. Against *Xanthomonas oryzae*, AT showed enhanced antibacterial activity, exhibiting a lower MIC (9.76 µg mL^{-1}) than ZT (78.12 µg mL^{-1}). At the highest concentration, AT produced a 19.0 ± 0.44 mm inhibition zone compared with 13.3 ± 0.36 mm for ZT.

Keywords: Green synthesis; ZnO; Ag-doped ZnO; *Curcuma longa*; nanomaterials; antibacterial activity; *Xanthomonas oryzae/*

ICEMSET-2026/ST/1128

Functionalized MXene-enabled Electrochemical Aptasensing: A Next-Generation Platform for sensitive and selective detection of Gluten

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Abstract

The increasing demand for reliable gluten detection highlights the importance of sensitive and selective analytical methods for ensuring the safety, quality, and authenticity of gluten-free food products. The detection of gluten is beneficial not only for identifying gluten-containing foods but also for diagnosing celiac disease. Herein, we developed a functionalized MXene-driven aptasensing platform for sensitive and selective detection of gluten. The developed aptasensor exhibited a broad detectable concentration range from sub-ppm to approximately 1000 ppm, with a linear response extending to around 100 ppm. A low-ppb-level detection limit was achieved for gliadin, demonstrating the suitability of the platform for trace-level gluten analysis. The sensor also exhibited remarkable selectivity toward gluten in the presence of other interfering food proteins. Furthermore, the developed sensing platform retained more than 80% of its initial response after 7 days of storage, demonstrating satisfactory operational stability. The practical applicability of the aptasensor was validated using real food matrices, including cookies and flour. Overall, the functionalized MXene-based aptasensor provides a sensitive, selective, and stable electrochemical platform for gluten monitoring, with potential applications in food quality control and the verification of gluten-free products.

Keywords: Gluten, Electrochemical, Sensing, Allergen, Celiac.

ICEMSET-2026/ST/1129

Microwave assisted interface engineering of Copper aluminate composites for asymmetric supercapacitor device: A sustainable electrode material

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Abstract

The emergence of alternative energy source and effective energy storage technology need has increased due to the rapid growth of fossil fuels and related environmental problems. Among these technologies, supercapacitors have attracted a lot of interest. Copper aluminate ($CuAl_2O_4$) is synthesized via a popular and effective microwave-assisted combustion technique because it has an impact on the nucleation and growth of the resulting nanostructures. In the fabricated three electrode system, $CuAl_2O_4$ achieved enhanced specific capacitance of 492.6 Fg^{-1} at a scan rate of 5 mVs^{-1}. In addition, the designed $CuAl_2O_4$/AC asymmetric device was assembled using $CuAl_2O_4$ as positive electrode and activated carbon is used as negative electrode which delivered a specific capacitance of 258 F g^{-1}, a maximum energy density of 34.83 W h kg^{-1}, and a power density of 336.7 W kg^{-1}, measured in 1 M KOH electrolyte at a current density of 1 A g^{-1}. It maintains capacitance retention of 87% over 7000 cycles at 4 Ag^{-1}. This work shows that microwave-assisted interface engineering is an effective strategy for synergistically optimizing both the structural and electronic properties of $CuAl_2O_4$ based composites, while controlling their structural evolution and electrochemical charge-storage kinetics.

Keyword: Copper aluminate, microwave-assisted combustion, Energy storage, Supercapacitor.

ICEMSET-2026/ST/1130

Recent Advances in FPGA-Based Fetal ECG Extraction

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Abstract

Non-invasive fetal electrocardiogram (fECG) monitoring is an important technique for assessing fetal cardiac activity and well-being during pregnancy. However, reliable extraction of fECG from maternal abdominal recordings is challenging due to maternal ECG interference, baseline wander, power-line noise, motion artifacts, and electromyographic noise. Recent research has introduced advanced signal-processing approaches, including adaptive filtering, blind source separation, wavelet-based denoising, empirical mode decomposition, and hybrid extraction methods. Field-programmable gate arrays (FPGAs) have also gained attention for real-time fECG processing because of their parallel processing capability, low latency, reconfigurability, and energy efficiency. This survey reviews recent advances in FPGA-based fetal ECG extraction, with emphasis on noise suppression, adaptive filtering, and SRAM-based hardware architectures. Existing implementations are compared based on extraction accuracy, signal-to-noise ratio, hardware resource utilization, power consumption, and operating frequency. Emerging challenges and future directions, including edge artificial intelligence, heterogeneous computing, and ultra-low-power architectures, are also discussed.

Keywords: Fetal ECG, FPGA, adaptive filtering, LMS algorithm, non-causal adaptive filtering, SRAM architecture, biomedical signal processing, fetal monitoring.

ICEMSET-2026/ST/1131

Near-Surface soil moisture measurement by using fractal antenna

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Abstract

In this work, a lotus shaped fractal antenna for near surface soil moisture measurements is proposed. The proposed antenna is designed with a coplanar waveguide (CPW) ground plane to give compact configuration and suitable for sensing applications. The antenna is installed close to the ground surface where the variation of the moisture content changes the dielectric properties of the surrounding medium and therefore the electromagnetic response of the antenna. The different soil moisture levels were analyzed for variation in resonant frequency, return loss and other important antenna parameters. The variation of these parameters can be related to the moisture content of the soil; thus the antenna can be used as a non-invasive soil moisture sensor. The proposed approach can be useful for near-surface soil monitoring and may have potential applications in smart agriculture, irrigation management, and environmental monitoring.

Keywords: lotus shaped fractal antenna, resonant frequency, soil moisture sensor, coplanar waveguide, smart agriculture.

ICEMSET-2026/ST/1132

Green Microwave-Assisted Fabrication of TiO_2/ZnO@ZrO_2 Nanocomposite: Structural, Optical and Surface Characterization for Photocatalytic Degradation of Methylene Blue, Methyl Orange and Rhodamine B and Dye-Sensitized Solar Cell Applications

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Abstract

The rational design of multicomponent metal-oxide nanocomposites through environmentally benign synthesis strategies has attracted increasing interest for applications in photocatalytic wastewater treatment and renewable-energy technologies. In this work, a TiO_2/ZnO@ZrO_2 nanocomposite (NC) was synthesized using a green microwave-assisted approach and systematically investigated for photocatalytic degradation of representative organic dyes and its potential application in dye-sensitized solar cells (DSSCs). The structural, morphological, compositional, thermal, vibrational, optical, and surface properties of the synthesized NC were investigated using scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), thermogravimetric–differential thermal analysis (TG–DTA), X-ray diffraction (XRD), Raman spectroscopy, Fourier-transform infrared spectroscopy (FTIR), photoluminescence (PL) spectroscopy, and zeta-potential analysis. The characterization results confirmed the formation of the multicomponent TiO_2/ZnO@ZrO_2 oxide system and indicated interactions among the constituent metal-oxide phases. The incorporation of ZnO and ZrO_2 into the TiO_2 matrix modified the optical and interfacial properties of the composite, with the PL response suggesting changes in the recombination behaviour of photogenerated charge carriers. The photocatalytic activity was evaluated using methylene blue (MB), methyl orange (MO), and rhodamine B (RhB) as model organic pollutants under irradiation. The TiO_2/ZnO@ZrO_2 NC demonstrated significant degradation of the investigated dyes, highlighting its potential for the treatment of chemically diverse organic pollutants in aqueous media. In addition, the synthesized nanocomposite was explored as a functional material for DSSC-related applications, where its structural and optical characteristics are relevant to photo-induced charge transport and interfacial charge-transfer processes. The combined photocatalytic and photovoltaic investigations demonstrate the multifunctional potential of the TiO_2/ZnO@ZrO_2 nanocomposite. Overall, this study highlights green microwave-assisted synthesis as a promising strategy for developing ternary metal-oxide nanocomposites for environmental remediation and emerging solar-energy applications.

ICEMSET-2026/ST/1133

Hybrid Deep Feature Extraction and Optimization-Driven Machine Learning for Automated Classification of Wheat Leaf Diseases

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Abstract

Wheat production is affected by various foliar diseases, emphasizing the need for reliable and automated disease recognition. This study proposes an integrated framework for multiclass wheat leaf disease classification by combining deep feature extraction with optimization-driven machine learning. Three publicly available image datasets were combined to obtain 6,884 images representing ten classes. Images were resized to 224 × 224 pixels, sharpened, and normalized. Training data were augmented through rotation, horizontal flipping, zooming, and brightness adjustment, resulting in 22,028 training images. ResNet50 with a Squeeze-and-Excitation attention mechanism was employed for deep feature extraction. Principal Component Analysis was used to reduce feature dimensionality, followed by Grey Wolf Optimization for selecting informative features. Five machine learning classifiers were evaluated. The Multi-Layer Perceptron achieved the highest performance, obtaining 96.08% accuracy and a 96.04% F1-score. The proposed framework demonstrates the potential of combining deep representations and optimization-based learning for automated wheat leaf disease classification.

Keywords: Wheat leaf disease; Deep feature extraction; ResNet50; Squeeze-and-Excitation; and Grey Wolf Optimization.

ICEMSET-2026/ST/1134

Negative Feedback-Regulated Silver Phosphate Nanozyme Platform for Colorimetric Chlorpyrifos Pesticide Detection

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Abstract

Chlorpyrifos is a commonly used organophosphate pesticide that poses serious environmental and health risks due to its residues in soil and agricultural products. We herein describe a rapid and selective colorimetric sensing strategy based on Silver Phosphate (Ag_3PO_4) nanoparticles (NPs) with intrinsic oxidase-mimicking activity. The synthesized NPs were characterized by FESEM, HR-TEM and XPS to evaluate their morphology, crystallinity, surface properties and oxidation states. Ag_3PO_4 NPs were found to catalyze oxidation of 3,3′,5,5′-tetramethylbenzidine (TMB) to give a blue colour. The sulfide ions generated in the presence of chlorpyrifos suppressed the catalytic activity of Ag_3PO_4 NPs and inhibited TMB oxidation and pesticide detection by feedback inhibition. The sensing system had a detection limit of ~9.97 ppm and a Km value of 0.15 mM. Further applicability validation was carried out on soil samples collected from villages of Pethapur and Chiloda.

Keywords: 3,3′,5,5′-tetramethylbenzidine, Chlorpyrifos, organophosphate, oxidase mimicking.

ICEMSET-2026/ST/1135

Performance Enhancement of a Strain-Engineered GaAsSb/InGaAs TFET-Based 7T SRAM for Ultra-Low-Voltage Operation

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Abstract

The ultra-low-voltage SRAM requires transistors with high drive current, low leakage, sharp switching characteristics, and enough noise margin. We demonstrate a 7T SRAM cell based on a strain- and composition-engineered GaAsSb/InGaAs heterojunction TFET for low-voltage operation. The proposed TFET is assisted by enhanced in composition and strain engineering to improve the band alignment and promote band-to-band tunnelling at the source-channel interface. The enhanced device is embedded in a 7T SRAM structure and examined in terms of ON-current, sub-threshold swing, leakage current, static noise margin (SNM), write margin, power consumption and power-delay product (PDP). Compared to the traditional Si/GaSb heterojunction TFET-based 7T SRAM, the proposed architecture exhibits 30% enhancement of ON-current, 20% reduction of subthreshold swing, 45% reduction of leakage current, 20% improvement of read SNM, 25% increase of write margin, 35% reduction of power consumption and 30% increase of PDP. The proposed device-circuit co-optimisation will demonstrate the potential of engineered III-V heterojunction TFETs for robust, power-efficient ultra-low-voltage SRAM applications.

Keywords: 7T SRAM TFET; Composition and Strain Engineering; GaAsSb/InGaAs Heterojunction; Ultra-Low-Voltage SRAM; Low-Power Memory.

ICEMSET-2026/ST/1136

A Materials-to-Device Framework for Comparative Evaluation of Wide-Bandgap Semiconductor Technologies

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Abstract

Semiconductor material selection is increasingly becoming a device-and-system design decision rather than a material-property choice alone. Conventional silicon continues to provide a mature and economical technology platform, but the simultaneous demand for higher voltage blocking, faster switching, greater power density, and improved thermal performance has accelerated the adoption of wide-bandgap (WBG) semiconductors. This paper presents a comparative materials-to-device framework for silicon (Si), silicon carbide (SiC), gallium nitride (GaN), gallium oxide (Ga_2O_3), diamond, and emerging two-dimensional (2D) semiconductors. The

proposed approach combines recent literature analysis, intrinsic material-property screening, a normalized Baliga-type figure of merit, and an illustrative 650-V half-bridge switching-loss model. Under common modeling assumptions, the device study evaluates conduction loss, switching loss, conversion efficiency, switching-frequency sensitivity, and first-order thermal stress. At 500 kHz and 4 kW output power, the representative model predicts semiconductor losses of 52.0 W for Si, 22.0 W for SiC, and 13.5 W for GaN, illustrating the increasing influence of switching energy as operating frequency rises. The study further demonstrates that intrinsic material superiority does not directly translate into system-level superiority because parasitic inductance, gate-drive conditions, thermal interfaces, dynamic on-resistance, reliability mechanisms, defects, and packaging technology strongly influence practical performance. The analysis therefore establishes a structured bridge between semiconductor material properties and electronic-device behavior, while distinguishing mature WBG technologies from emerging ultra-wide-bandgap and 2D technologies. The resulting framework can support early-stage material/device selection for high-efficiency power converters and provides a basis for future TCAD, electro-thermal, reliability, and experimentally validated investigations.

Keywords: Semiconductor Materials, Silicon Carbide, Gallium Nitride, Wide-Bandgap Devices, MOSFET, HEMT, Power Electronics, Device Simulation.

ICEMSET-2026/ST/1137

Low-Leakage 8T SRAM Cell Using Sleep-Transistor-Assisted Adaptive Reverse Body Biasing for Energy-Efficient Memory Applications

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Abstract

SRAM (Static Random Access Memory) is a type of memory characterised by fast operation and non-refreshing data retention, making it a preferred choice for processor caches and high-performance applications. However, the growing subthreshold leakage and standby power consumption remain major obstacles in low-voltage memory applications. The conventional 8T SRAM enhances read stability through a dedicated read port; however, the additional transistors can create leakage paths and increase standby power consumption. In this paper, we propose an 8T SRAM cell with low leakage using sleep-transistor-assisted adaptive reverse body bias. The proposed cell guarantees reliable read and write operations during active operation, while in standby mode, the sleep transistor cuts off the leakage-prone paths, and reverse body biasing increases the effective threshold voltage of the selected transistors. This system mitigates subthreshold leakage while maintaining data integrity and cell stability. In contrast to traditional 8T SRAM, the proposed design aims for an approximate 35% reduction in standby leakage current and a 30% reduction in standby power consumption, while maintaining negligible effects on read/write efficiency. The design is appropriate for energy-efficient, low-power SRAM applications.

Keywords: 8T SRAM, Leakage Reduction, Reverse Body Biasing, Sleep Transistor, Low-Power Memory.

ICEMSET-2026/ST/1138

Experimental Evaluation of Mechanical Properties of Hybrid Fiber Epoxy Composites

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Abstract

This study examines the influence of alkali treatment and bamboo fiber content on the mechanical behavior of bamboo-glass fiber-reinforced epoxy composites. Bidirectional bamboo fiber is combined with two outer layers of E-glass fiber, while 6, 8, and 10 bamboo layers provide bamboo contents of 17, 22, and 26 wt.%, respectively. Before fabrication, the bamboo fibers are treated utilizing 5 wt.% sodium hydroxide solution. The laminates are fabricated using hand lay-up followed by compression molding and evaluated under tensile and three-point flexural loading. Increasing the bamboo fiber content progressively improves the mechanical

properties. The untreated composites exhibit maximum tensile and flexural strengths of 120 and 180 MPa, respectively. Following alkali treatment, these values increase to 155 and 215 MPa, with corresponding moduli of 3.7 and 6.0 GPa. Scanning electron microscopy reveals improved interfacial adhesion and reduced fiber pull-out after alkali treatment. These findings demonstrate the potential for semi-structural and structural applications.

Keywords: Bamboo fiber; Glass fiber; Epoxy; Alkali treatment; Mechanical properties.

ICEMSET-2026/ST/1139

Adaptive OFDM-Based Airborne Transmitter Module for Real-Time Aircraft Telemetry: System Design and Functional Simulation

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Abstract

Real-time transmission of aircraft data to the ground needs a wireless link that stays dependable as flying conditions change. This study designs and simulates an airborne transmitter module for a real-time aircraft telemetry system. The module handles flight data, cockpit audio, and cockpit video, ranking them by importance so that flight data is always protected and video is reduced first when the channel weakens. It uses Orthogonal Frequency Division Multiplexing, which splits data across many parallel carriers, and automatically switches between three modulation levels (QPSK, 16-QAM, and 64-QAM) according to measured channel quality. Convolutional error-correction coding adds further protection. The complete transmit-and-receive chain was simulated in MATLAB over a noisy channel, and the bit error rate was evaluated. Coding improved performance by about 6 dB for all three modulation levels at an error rate of one in 100,000. The module chose the correct modulation level for each signal quality and cut video first, keeping flight data intact in every test. The design offers a reliable, flexible, and bandwidth-efficient basis for real-time aircraft telemetry.

Keywords: *OFDM, adaptive modulation, aircraft telemetry, bit error rate, convolutional coding, priority multiplexing.*

ICEMSET-2026/ST/1140

Unveiling the Bioactive Potential of *Moringa oleifera* L. Leaf Extracts for Sustainable Plant Protection

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Abstract

Moringa oleifera L., the "miracle tree," is renowned for its rich phytochemical profile and broad-spectrum bioactivity. This study evaluated the antifungal potential of *Moringa oleifera* leaf extracts against *Rhizoctonia solani*, a devastating soil-borne pathogen causing sheath blight in rice. Leaf samples from PKM-1, ODC-3, and organic moringa leaf powder (OML) were extracted using methanol, ethyl acetate, hexane, and water. Antifungal screening via the poisoned food technique revealed that methanolic extracts exhibited the strongest mycelial inhibition, with PKM-1 recording the lowest EC_{50} (257.03 µg/mL), followed by ODC-3 (282.57

µg/mL) and OML (297.23 µg/mL). Methanol extracts also showed the highest total phenolic (38.11 mg GAE/g) and flavonoid (15.25 mg QE/g) contents in PKM-1. GC-MS profiling identified bioactive compounds including α-linolenic acid, neophytadiene, phytol, and dl-α-tocopherol. These findings suggest that methanolic extracts of *Moringa oleifera*, particularly PKM-1, hold promise as eco-friendly antifungal agents for sustainable rice cultivation.

Keywords: *Moringa oleifera*; Antifungal activity; *Rhizoctonia solani*; EC_{50}; Methanolic extract; GC-MS profiling.

ICEMSET-2026/ST/1141

Effect of Al_2O_3 phase on magnetic and magnetotransport properties of $La_{0.7}Ca_{0.3}MnO_3$:Al_2O_3 nanocomposites

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Abstract

This study investigates Al_2O_3 incorporation into $La_{0.7}Ca_{0.3}MnO_3$ (LC3MO) to enhance magnetoresistance (MR) via grain-boundary (GB) engineering. Phase formation and crystal structure were analyzed using X-ray diffraction and Rietveld refinement. LC3MO crystallized in the orthorhombic *Pnma* structure, while Al_2O_3 exhibited a cubic γ-phase, consistent with FTIR results. Morphological and microstructural characteristics were examined using FESEM and TEM. The M–H measurements revealed RT paramagnetism and low temperature ferromagnetic ordering. Increasing Al_2O_3 concentration enhanced resistivity, reaching 530 Ω cm for 20% Al_2O_3, which is more than 600 times higher than that of pristine LC3MO (0.85 Ω cm). The nature and mechanism of electrical transport in various temperature ranges are explained using different theoretical models. Temperature-dependent resistivity indicated T_{M-I} of 190-140 K under different magnetic fields. Holstein's relation confirmed the NASPH model as the dominant transport mechanism. GB regulated maximum MR of ~55% at 6 T and LFMR exceeding 23% below 0.5 T were observed.

Keywords: composite, magnetic ordering, magnetoresistance, LFMR, spinpolarized tunneling.

ICEMSET-2026/ST/1142

Refractive index measurement of RNA VO molecule and its dependence on Temperature

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Abstract

To comprehend solvent solute interactions and the physicochemical behaviour of the system, the refractive index's temperature reliance and viscosity of solutions containing the RNA VO (Schiff based metal complex Riluzole drug) molecule in various organic solvents was examined. A digital refractometer RX-5000i series Atago was used to measure the refractive index throughout a temperature range of 283-343 0K. The findings demonstrate that for all solvents examined, the refractive index of the RNA-VO solution falls linearly with temperature. This is explained by the medium's decreased density and molecule polarizability at higher temperatures. Concurrently studies of viscosity showed a slow drop with temperature as a result of increased molecular mobility and less intermolecular interactions. The relationship between viscosity and refractive index

sheds insights on the RNA-VO complex's microenvironment and emphasize how temperature and solvent polarity affect the system's optical and transport characteristics. The solvent -dependent behaviour of biomolecular metal complexes in solution is better understood as result of their discoveries.

Keywords: Refractive index measurement, Abbe's Refractometer, Viscosity, Temperature, Fluorescent compound, RNA VO molecule.

ICEMSET-2026/ST/1143

Experimental Investigation of X-Ray Mass Attenuation Coefficients in Hydrocarbon Samples Using a Si (Li) Detector

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Abstract

The present study investigates the interaction of X-rays with hydrocarbon materials through experimental determination of their mass attenuation coefficients. Hydrocarbon samples were irradiated using characteristic X-rays produced through a secondary-excitation arrangement, and the transmitted radiation was recorded using a Si (Li) detector coupled to a multichannel analyzer. Measurements were carried out for different photon energies and sample thicknesses to determine the corresponding attenuation behavior. The mass attenuation coefficients were evaluated from the measured incident and transmitted intensities using the Beer–Lambert attenuation relation. The experimental values were compared with theoretical mass attenuation coefficients obtained from the NIST XCOM database. The influence of photon energy and sample composition on the attenuation coefficients was examined, and the agreement between experimental and theoretical results was evaluated. The study provides quantitative information on the X-ray attenuation characteristics of hydrocarbon materials and demonstrates the applicability of experimental X-ray transmission measurements for their characterization.

Keywords: X-ray attenuation; Mass attenuation coefficient; Hydrocarbon samples; Si (Li) detector; Photon–matter interaction.

ICEMSET-2026/ST/1144

Design and Implementation of a Real-Time FFT-Based FX Auto-Correlator on the Red Pitaya STEMlab 125-14 Platform

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Abstract

Digital correlators provide high-resolution spectral analysis for radio astronomy and interferometry applications. This work presents the design and real-time implementation of a resource-efficient FFT-based FX auto-correlator for radio astronomy using the Red Pitaya STEMlab 125-14 platform with a Xilinx Zynq-7010 SoC. This approach uses pipelined 1,024-point FFTs and 4,096-frame BRAM-based accumulators to process a continuous stream of 125 MSPS, 14-bit ADC data without ADC loss, thereby improving spectral sensitivity. Prior to its deployment in radio astronomy, the ADC's performance is characterized on a ZCU111 RFSoC, achieving 9 bits of ENOB at 390 MHz. A comprehensive simulation framework is developed to model quantization, windowing, and spectral effects for hardware validation purposes. Results show that the current FPGA implementation uses only 24.06% of the available LUTs and roughly 30% of the available BRAM resources, demonstrating that low-cost, portable hardware can perform high-quality spectral processing with a large integration depth for long observations.

Keywords: FFT; FPGA; Digital Autocorrelator; Radio Astronomy; Zynq SoC; Red Pitaya; ADC characterization.

ICEMSET-2026/ST/1145

From First Trimester to Delivery: Mapping AI/ML Approaches for Fetal Health Monitoring Across the Pregnancy Continuum

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Abstract

Pregnancy discloses as a continuum of clinical checkpoints: First trimester screening, Second and Third trimester anatomical, growth observation and intrapartum monitoring during delivery. Each with different risk windows, imaging or signal modalities, and diagnostic objectives. This paper provides a comprehensive survey of publicly accessible and privately reported datasets utilised for fetal health assessment mapped onto three continuum phases: (a) First trimester, including early risk assessment and estimation of gestational age and biometry (b) Second and third trimesters, including standard anatomical and facial plane classification, fetal head and organ biometry and the identification of structural brain and multi-organ anomalies (c) delivery, including wearable phonocardiography monitoring, fetal electrocardiogram extraction, and hypoxia and distress identification using intrapartum cardiotocography. The majority of the reviewed work reports high in distribution accuracy using convolutional and transformer-based architectures, attention mechanisms, diffusion-based augmentation and hybrid signal processing pipelines. We identify several limitations, such as the scarcity of datasets, the narrow demographic representation, the inadequate cross-phase and cross-centre validation, the limited explainability and the lack of patient data from South Asia and India. We suggest future directions that focus on federated multi-centre validation, lightweight models for low-resource deployment, longitudinal multimodal fusion throughout the pregnancy continuum and the development of benchmark datasets specific to India that cover the first trimester through delivery.

Keywords: Artificial Intelligence, Cardiotocography, fetal ECG, Fetal health monitoring, First trimester screening, machine learning, multimodal fusion, pregnancy continuum, ultrasound.

ICEMSET-2026/ST/1146

Explainable Artificial Intelligence-Assisted Prediction and Interpretation of Methylene Blue and Methyl Red Photocatalytic Degradation Using Carbon Dots

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Abstract

The contamination of water resources by synthetic dyes is an increasing environmental concern due to their persistence, complex chemical structures, and potential adverse effects on aquatic ecosystems. Conventional wastewater treatment methods may not be sufficient for the complete removal of dye pollutants, creating a need for efficient, sustainable, and advanced treatment approaches. Photocatalytic degradation has emerged as a promising technique for the removal of organic dyes through light-induced chemical reactions. Carbon dots (CDs), a class of carbon-based nanomaterials with tunable optical properties, abundant surface functional groups, aqueous stability, and low toxicity, have attracted considerable attention for photocatalytic applications. In the present study, carbon dots synthesized from a natural precursor are investigated for the photocatalytic degradation of Methylene Blue (MB) and Methyl Red (MR) dyes in aqueous media. The synthesized carbon dots were characterized using UV-Visible and Fourier Transform Infrared (FTIR) spectroscopy. An automated computational workflow was developed to support spectral-data validation, artifact detection, identification of characteristic absorption features, and visualization. UV-Visible analysis revealed a distinct absorption maximum at 294 nm, while FTIR analysis exhibited characteristic bands at 3414, 2922, 1629, 1409, 1063, and

649 cm^{-1}, indicating the presence of various surface functional groups, including hydroxyl/amine, aliphatic C–H, carbonyl/aromatic C=C, and related functionalities. Photoluminescence (PL), X-ray diffraction (XRD), and direct and indirect band-gap estimation using Tauc plots are ongoing. The next stage of the work focuses on evaluating the photocatalytic degradation efficiency of the synthesized carbon dots toward MB and MR dyes under controlled experimental conditions. The degradation process will be monitored using UV-Visible spectroscopy by analysing the changes in the characteristic absorption peaks of the respective dyes. Degradation efficiency, concentration variation, and photocatalytic kinetic parameters will subsequently be determined. Machine-learning models will then be developed to predict degradation efficiency and degradation kinetics using experimental and spectral parameters. Explainable Artificial Intelligence (XAI) techniques will be incorporated to identify and interpret the most influential features responsible for the model predictions.
The proposed framework integrates green nanomaterial synthesis, photocatalysis, spectroscopic characterization, machine learning, and Explainable AI to develop an interpretable data-driven approach for synthetic dye wastewater treatment. The study aims not only to predict the photocatalytic degradation performance of carbon dots toward MB and MR but also to provide an interpretable understanding of the relationship between carbon-dot properties, experimental conditions, spectral characteristics, and dye degradation behaviour. This integrated approach may contribute to the development and optimization of efficient, sustainable, and explainable photocatalytic systems for wastewater treatment.

Keywords: Carbon dots; Methylene Blue; Methyl Red; Photocatalytic degradation; Machine Learning; Explainable Artificial Intelligence; UV-Visible spectroscopy; Dye wastewater treatment; Photocatalysis; Kinetic analysis.

ICEMSET-2026/ST/1147

Self-Healing AI-Based OFDM Transceiver for Adaptive Modulation Under Unseen Channel Conditions

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Abstract

The usefulness of adaptive modulation in an OFDM link depends on how closely a learned decision rule matches the propagation environment, and this match deteriorates when the channel moves beyond training conditions. This paper presents a self-healing OFDM transceiver using a weighted k-nearest-neighbour (kNN) classifier to select BPSK, QPSK, 16-QAM and 64-QAM from ten channel descriptors instead of SNR alone. Feature-space channel distance, prediction confidence and prediction uncertainty are tracked at every frame. When any indicator crosses its threshold, a few labelled samples from the current channel are gathered and appended to classifier memory, refreshing the decision rule without offline retraining. MATLAB simulations over 250 frames included Rayleigh, frequency-selective Rayleigh, Rician-with-Doppler and mixed channels. The system achieved an overall BER of 0.0254, average throughput of 2.41 bits/subcarrier, 131 adaptation events and mean recovery time of 2.78 frames, demonstrating response to unfamiliar channel conditions.

Keywords: OFDM; Adaptive Modulation; Weighted k-Nearest Neighbours; Unseen Channels; Few-Shot Learning.

ICEMSET-2026/ST/1148

Effect of Annealing Temperature on the Structural, Optical, and Textural Properties of Melamine-Derived Graphitic Carbon Nitride

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Abstract

Graphitic carbon nitride g-C_3N_4 is a promising metal-free, polymeric semiconductor material due to its favourable visible-light-responsive band gap (~2.7 eV), high chemical and thermal stability, non-toxicity, and

ease of synthesis from low-cost, nitrogen-rich precursors. Although g-C_3N_4 has many advantages, its practical performance in photocatalytic and energy-related applications is often limited by its low specific surface area, rapid recombination of photogenerated charge carriers, and bulk agglomerated morphology inherited from conventional synthesis routes. Among the different synthesis factors, the annealing temperature during thermal polycondensation has a significant impact on the material's ultimate structural and morphological properties. This study synthesized g-C_3N_4 through direct thermal polycondensation of melamine in a covered crucible under static air. The effect of annealing temperature on its structural, morphological, optical, and textural properties was systematically investigated across a defined temperature range. The resulting material were characterized using XRD to assess crystallinity and interlayer stacking, Fourier-transform infrared spectroscopy (FTIR) to confirm characteristic heterocyclic ring vibrations, scanning electron microscopy (SEM) to evaluate surface morphology, UV-visible diffuse reflectance spectroscopy (UV-DRS) to determine optical absorption behaviour and band gap energy. All of these results show that the microstructure, textural characteristics, and optoelectronic performance of g-C_3N_4 are controlled by the crucial and readily adjustable annealing temperature. With major implications for improving g-C_3N_4 performance in photocatalytic water splitting, pollutant degradation, and other energy and environmental applications, this study provides a straightforward, economical, and scalable method for modifying its morphology.

ICEMSET-2026/ST/1149

Green Electronics for Healthcare: Compostable Bio-DSSCs Using Agricultural By-Products

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Abstract

This study demonstrates the integration of potato starch biopolymer substrates and pomegranate anthocyanin dye sensitizers to develop fully biodegradable Dye-Sensitized Solar Cells (DSSCs) optimized for monitoring micro-mini-sensors. While offering high eco-compatibility, raw starch-based photovoltaics typically suffer from severe performance limitations due to moisture susceptibility and thermal dye instability. To resolve these vulnerabilities, we analyze a combination of citric acid chemical cross-linking, zinc oxide nanoparticle (ZnO NPs) reinforcement, and a beeswax-derived hermetic sealing encapsulation. Fabricated using locally sourced, low-cost organic materials, the developed prototype achieves a highly economical per-unit production cost of Rs. 145. Experimental data reveals that the cross-linking modification paired with the hydrophobic beeswax coating reduces moisture absorption by 78%. Consequently, the functional lifespan of the bioplastic sensor is extended from a mere 48 hours to over 45 days under ambient field conditions, after which the device completely degrades safely directly on the skin over a 60-day period. The breakdown process triggers via a combination of moisture activation, enzymatic breakdown, and natural metabolic assimilation, leaving absolutely zero toxic residues. The resulting organic photovoltaic device operates within a power conversion efficiency (η) range of 0.2% to 0.6%, successfully delivering a targeted power output of 2 μW and 2 mW/cm^2. This integration presents a highly sustainable, renewable, carbon-based energy solution specifically tailored for low-power health microelectronics and wearable self-powered biosensors.

Keywords: Dye-Sensitized Solar Cells (DSSCs), Potato Starch Biopolymer, Pomegranate Anthocyanin, Biodegradable Electronics, Hydrophobic Encapsulation, Organic Photovoltaics.

ICEMSET-2026/ST/1150

2D material based memristors for neuromorphic computing applications

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Abstract

Neuromorphic computing offers an energy-efficient alternative to traditional von Neumann architectures by integrating memory and processing to mimic biological neural systems. Two-dimensional (2D) materials, particularly molybdenum disulfide (MoS_2) can be useful materials in such computing systems due to their low

thickness, superior electrostatic control, high mechanical flexibility, and tunable electronic properties. Beyond conventional data storage, 2D (MoS_2) based memristors excel in neuromorphic hardware by serving as artificial synapses. This work presents an ultrathin (MoS_2) memristor capable of low-power analog resistive switching. Driven by defect engineering and electric-field-induced ion migration, the device emulates essential biological synaptic functions, including long-term potentiation (LTP), long-term depression (LTD), and paired-pulse facilitation (PPF), displaying high operational linearity and state retention. These results highlight 2D (MoS_2) memristors as promising hardware candidates for scalable, ultra-dense, and low-power neuromorphic computing architectures.

Keywords: Neuromorphic computing; memristor; 2D materials; Transition metal dichalcogenides, TMDCs.

ICEMSET-2026/ST/1151

Multi-Input Convolutional Neural Network for Condition Monitoring of Rotating Machinery

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Abstract

Predictive maintenance is an important technology deployed by modern industries to reduce machine down-time, reduce maintenance costs and prevent unexpected equipment failures. Bearings are one of the critical components of rotating machinery, and the faults of bearings can lead to serious performance degradation if not detected in time. In this work, a Multi-Input Convolutional Neural Network (CNN) based prediction-based maintenance system is proposed for automatic bearing fault detection from vibration spectrogram images and RPM and temperature sensor data. In this system, vibration signals from bearings are converted into spectrogram images using signal processing techniques, such as FFT and STFT. These spectrograms are time-frequency features of machine vibrations and are used as image inputs to the CNN model. Additionally, RPM and temperature values are used as extra scalar inputs to improve the accuracy of fault detection via the fusion of the sensors. The proposed model classifies bearing into four conditions: Inner race fault, Outer race fault, Ball defect and Cage fault. Various techniques like Batch Normalization, Dropout, L2 Regularization, Data Augmentation and Learning Rate Scheduling are used to enhance the performance of the model and to avoid the overfitting. In order to simulate industrial conditions, noise robustness tests were also carried out. The experimental results showed that the fault classification was highly accurate, validating the effectiveness of the proposed AI-based predictive maintenance system for Industry 4.0 and smart manufacturing applications.

ICEMSET-2026/ST/1152

Sustainable Polymers and Circular Materials for Sustainable Textiles

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Abstract

The textile and fashion sector have significant environmental impacts through resource use, synthetic fibre production, and growing textile waste. Sustainable polymers and circular materials offer opportunities to address these issues by developing alternatives to conventional textile materials and improving resource recovery. This paper discusses bio-based polymers, recycled polymers, regenerated fibres, and textile-based composites in terms of their potential to foster circular textile production. Special attention is given to turning pre- and post-consumer textile waste into higher-value materials, reducing reliance on virgin resources and lengthening material life-cycles. This study uses a qualitative exploratory approach based on a review of existing literature and documented sustainable material practices. It discusses how material innovation, recycling, reuse, and circular design strategies improve textile sustainability. The paper highlights the role of sustainable polymer technologies and circular material approaches in reducing waste, improving resource efficiency, and developing more responsible textile and fashion systems.

Keywords: Sustainable Polymers, Circular Economy, Textile Waste, Recycled fibres, Circular Textile material.

ICEMSET-2026/ST/1153

Unraveling Antenna Behavior in Porphyrin Hydrogen-Bonded Organic Frameworks: A TD-DFT and FRET Study

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Abstract

Arrays of light-harvesting molecules with long-range order are promising materials for photons collection and rapidly transfer of solar energy to chemical catalysts. Hydrogen-bonded organic frameworks (HOFs) are particularly attractive as artificial light-harvesting platforms due to their crystalline nature, molecular-scale porosity and comparative ease of synthesis. We present a theoretical investigation of antenna-like light-harvesting behavior in partially metalated porphyrin-based hydrogen-bonded organic frameworks (HOFs) containing both zinc−metalated tetrakis (4-carboxyphenyl) porphyrin (Zn-TCPP; donor) and corresponding free-base porphyrin (FB-TCPP; acceptor) using Förster theory and ab initio calculations. Forster resonance energy transfer (FRET) analysis reveals that energy transfer efficiencies in the HOFs deviate markedly from the solution case due to the fixed orientations of the porphyrin and interlayer transfer rate dominates with respect to the other possible transfer directions in the superstructure. FRET modeling indicates that ~35 ZnTCPP molecules are enough to transfer energy to a centrally sited acceptor (FB-TCPP) molecule. These findings suggest that stacked chromophores within HOFs can act as light harvesting “antennae” and may offer prospective application as photochemical energy conversion systems.

We acknowledge the support by projects RYC2021-033818-I, funded by MCIN/AEI/10.13039/501100011033 and European Union “NextGenerationEU”/PRTR; ED431F 2024/21, ED481A/2023-087, and ED431G 2023/06: Centro Singular de Investigación de Galicia accreditation 2023–2027 funded by Xunta de Galicia.

ICEMSET-2026/ST/1154

A Trust-Aware and Time-Efficient Framework for Evidence-Verified Autonomous Cyber Threat Response and Adaptive Recovery

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Abstract

As cyberattacks have become more complex, they have placed greater demands on autonomous defense systems that can identify threats, select and implement appropriate defense actions, and determine if they are effective. We present in this paper a trust-aware and time-efficient autonomous cyber threat response and adaptive recovery framework. The framework combines TCN threat detection, Temporal Attack Graphs for attack investigation, RAG with MITRE ATT&CK for contextual knowledge, evidence trust and fusion, constrained LLM-based attack response planning, and MAPPO-based execution. Responses to candidates are evaluated prior to action using evidence, anticipated threat reduction, asset criticality, operational impact, and response constraints. The system then checks if the threat has been contained by comparing the security state before and after the response. If the response is partially successful or ineffective, the framework re-investigates and develops a new response plan. Experimental results indicate that the detection accuracy is 91–93%, the response success rate is 92–94%, the threat containment success rate is 90–93%, and the recovery success rate is 88–91%, while an average latency of 2–3 s and 25–30% fewer ineffective responses are achieved.

Keywords: Autonomous cyber defense, Cyber threat, response, TCN, Temporal Attack Graph, RAG, LLM, MAPPO, Evidence Verification.

ICEMSET-2026/ST/1155

Experimental Investigation on the Mechanical Properties of Carbon Fiber Reinforced Polymer for Concrete Structural Application

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Abstract

This study experimentally evaluates externally bonded carbon fibre reinforced polymer (CFRP) sheets for improving the compressive and flexural performance of plain cement concrete (PCC). Eighteen M20 concrete specimens, including six cubes, six cylinders, and six beams, were prepared and water-cured for 28 days. Three cylinders were circumferentially wrapped with CFRP, while three beams were strengthened on their tension faces using CFRP sheets bonded with epoxy. The remaining specimens served as controls. After 72 hours of adhesive curing, compression and four-point bending tests were conducted. CFRP confinement increased mean cylinder compressive strength from 21.79 to 31.18 MPa, a 43.1% improvement. Beam strengthening increased mean ultimate load from 34.27 to 47.73 kN and flexural strength from 17.13 to 23.87 MPa, both by about 39.3%. Mid-span deflection decreased by 28.7%, while crack initiation and propagation were delayed, demonstrating CFRP's effectiveness in strengthening concrete members.

Keywords: CFRP; concrete confinement; external strengthening; compressive strength; flexural behaviour; four-point bending.

ICEMSET-2026/ST/1156

Computational Assessment of Groundwater Potability in the Arid Béni Ounif Syncline, Southwestern Algeria: Water Quality Indexing, Statistical Analysis, and Bootstrap-Based Nitrate Health Risk Evaluation

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Abstract

Groundwater is the principal water resource in the arid Béni Ounif region of southwestern Algeria, making reliable assessment of potability essential for sustainable domestic water management. This study evaluates groundwater suitability for human consumption using 46 samples from the shallow and Continental Intercalaire (CI) aquifers through physicochemical characterization, the Groundwater Quality Index (GWQI), and deterministic and bootstrap-based probabilistic nitrate risk assessment. Most waters were fresh to brackish and hard to very hard, with pH values within the commonly adopted drinking-water range. The GWQI classified 80% of shallow-aquifer samples as good, 13.33% as excellent, and 6.67% as poor, whereas all CI samples were classified as good. Several shallow wells exceeded selected limits for nitrate, total dissolved solids, electrical conductivity, and hardness. Nevertheless, deterministic and bootstrap analyses yielded hazard quotients below 1, with a 0% probability of exceeding this threshold for adults, children, and infants under adopted exposure assumptions across both aquifers.

Keywords: Béni Ounif; groundwater potability; GWQI; hydrochemistry; statistical analysis; bootstrap; nitrate; health risk; computational assessment.

ICEMSET-2026/ST/1157

Pitting Corrosion Susceptibility Prediction via Machine Learning: Compositional and Environmental Determinants Across Fe, Al, NiCrMo and High-Entropy Alloys

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Abstract

Pitting corrosion initiated by chloride attack on passive films is a critical degradation mode in engineering alloys. Conventional prediction relies on empirical descriptors such as the Pitting Resistance Equivalent (PRE), which capture only compositional effects and ignore environmental variables. This study applies machine learning to predict pitting potential (Epit, mV vs. SCE), a quantitative electrochemical measure of localised corrosion resistance using 746 experimental records spanning Fe-based, Al-based, NiCrMo and high-entropy alloys. Input features included alloy composition, chloride concentration, pH, temperature and domain-engineered descriptors (PRE, WRC-1992 Cr equivalent). XGBoost regression achieved a test R^2 of 0.803 and RMSE of 188 mV, outperforming Ridge regression and Random Forest baselines. SHAP-based interpretability confirmed PRE and Cr equivalent as dominant predictors, independently recovering established passive-film science. Metallurgical validation on standard grades (AISI 304, 316L, duplex 2205, super-duplex 2507) confirmed physically consistent resistance rankings.

Keywords: Pitting corrosion, pitting potential, machine learning, SHAP interpretability, materials informatics.

ICEMSET-2026/ST/1158

Performance Analysis of PV-Fed PMSM Motor Drive Employing a Zeta Converter for Regenerative Braking

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Abstract

Population growth and the growing need for sustainable electric mobility will mean that efficient, reliable motor drive systems are needed. This paper displays a performance analysis of the solar-photovoltaic (PV) source-based drive of a permanent magnet synchronous motor (PMSM) connected with Zeta DC-DC converter which has been provided with the Regenerative braking feature. The Zeta converter, which keeps the DC-link voltage constant regardless of irradiance, eliminates the problem of DC-link polarity inversion, thus allowing to obtain smooth current characteristics and also to suppress ripple. A feedback control is provided to allow the stable operation in the motoring and regenerative modes. The system is modelled and simulated in MATLAB/Simulink and the performance is analysed for different solar radiation and load scenarios. Dynamic results show motoring efficiency of 94.2%, regenerative efficiency of 89.7% and a DC-link voltage regulation of less than ±2.1%. The proposed framework provides a stronger solution towards the sustainable electric vehicle propulsion systems.

Keywords: Solar Photovoltaic Energy, Permanent Magnet Synchronous Motor, Zeta DC–DC Converter, Regenerative Braking, Electric Vehicle, DC-Link Voltage Regulation, Renewable Energy Integration.ab.

ICEMSET-2026/ST/1159

Novel SiO_2 – ORMOSIL based Sol-gel Coating for corrosion protection of 6061 Aluminum Alloys for Aerospace Application

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Abstract

Aluminium alloy AA6061 is widely used in aerospace owing to its favourable strength-to-weight ratio, excellent weldability, formability, machinability, and corrosion resistance. However, its susceptibility to localized

corrosion, particularly pitting and intergranular attack, remains concern in chloride-containing environments. This study focuses on synthesis and optimization of silicon–zirconium hybrid sol–gel coating for AA6061 using an organic-modified silane (ORMOSIL) precursor and zirconium(IV) n-propoxide, applied by spray coating. Colloidal SiO_2 was incorporated to improve coating uniformity and minimize cracks. Processing and formulation parameters were optimized using a Design of Experiments (DoE) approach. The surface morphology, chemical structure, and topographical characteristics were evaluated using scanning electron microscopy (SEM), attenuated total reflectance Fourier-transform infrared spectroscopy (ATR-FTIR), and atomic force microscopy (AFM), respectively. Coating adhesion was assessed using the cross-hatch method according to ASTM D3359. Corrosion protection was evaluated through potentiodynamic polarization and electrochemical impedance spectroscopy (EIS) in 3.5% NaCl, comparing coated and uncoated AA6061.

Keywords: Design of Experiment, Optimization, Sol-gel coating, corrosion resistance, Aerospace Application.

ICEMSET-2026/ST/1160

A Hybrid Word - Character TF-IDF and Class-Balanced Linear SVM Framework for Multi-Class Fake News Detection

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Abstract

The growing prevalence of false information on the internet highlights the need for effective fake news detection that is efficient and fast. This article proposes a hybrid method that combines Word- and Character-Level TF-IDF features with a class-balanced Linear Support Vector Machine (SVM) for multi-class fake news detection. To enhance the quality of the data, text cleaning, title-content integration, and precise and near-duplicate removal are carried out. On 1-3-grams, words and context are captured using Word TF-IDF, but subword and stylistic patterns are captured with Character TF-IDF on 3-5-grams. An optimized Linear SVM is used to classify the fused features and regularization parameters are selected with a five-fold stratified cross-validation method. With C = 1.0, the mean accuracy on 18,025 news articles from five classes was 90.90% ± 0.33% and the MCC was 0.8469. We found that class-balanced Linear SVM and hybrid TF-IDF representation are good at detecting multi-class fraudulent news.

Keywords: Fake News Detection, Machine Learning, TF-IDF Features, RF, SVM, DT.

ICEMSET-2026/ST/1161

Triplet Energy Harvesting in Phenothiazine- Quinoline based Donor-Acceptor Conjugates via Exergonic Reverse Intersystem Crossing

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Abstract

Reverse intersystem crossing (RISC) in thermally activated delayed fluorescence (TADF) materials is typically limited by endergonic energy barriers imposed by conventional singlet–triplet ordering and spin selection rules. The realization of an inverted ^{1}CT–^{3}CT energetic hierarchy introduces a new class of 'energy-inverted emitters', in which spin-forbidden up-conversion is no longer thermally activated but proceeds through an intrinsically downhill pathway. In this work, we report a strategy that circumvents these constraints through the realization of *exergonic* RISC driven by an anomalous inversion between singlet and triplet charge-transfer (CT) states. The donor–acceptor emitter, DPTZQF, was synthesized to harness this inverted CT landscape, in which the triplet CT state lies above its singlet counterpart. In addition, the molecule is engineered to maintain a closely aligned local triplet excited state (^{3}LE), which mediates strong spin–vibronic interactions between ^{3}CT and ^{1}CT manifolds. Temperature-dependent photoluminescence dynamics, time-resolved spectroscopy, and phosphorescence analyses collectively confirm a negative singlet–triplet CT gap ($-\Delta E_{^1CT-^3CT}$ = 0.15 eV at 300 K) and a small ^{3}LE–^{3}CT separation of 0.05 eV. These features cooperatively promote highly efficient

exergonic RISC, yielding rate constant up to 2.1 × 10^8 s^{-1}. Our findings establish energy-level inversion as a powerful design principle for next-generation TADF emitters and provide new insight into bypassing the conventional spin-statistical bottleneck in organic light-emitting systems.

ICEMSET-2026/ST/1162

Glass transition temperature dependence on coordination number for Se-Te-Ge-Bi chalcogenide alloys

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Abstract

In the present work, Differential scanning calorimetry (DSC) is employed for thermal study of $(Se_{80}Te_{20})_{94-x}Ge_6Bi_x$ (x=0, 4, 8 and 12) bulk samples under non-isothermal conditions. Glass transition temperature (T_g) of investigated alloys has been deduced theoretically using Tanaka approach and modified Gibbs DiMarzio relation and dependence on average coordination number (<*r*>) is analyzed. Trends of experimental and theoretical results are compared with each other to observe variation of T_g with <*r*>.

ICEMSET-2026/ST/1163

An Integrated Process and Apparatus for Autogenous Synthesis of Diammonium Phosphate (DAP) Fertilizer from Cattle Waste

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Abstract

The current study addresses dual challenges of agricultural waste management and green fertilizer production by formulating a decentralized chemical process to capture nitrogen. A closed-loop, two-stage ambient-temperature system is engineered to directly synthesize pure liquid diammonium phosphate (DAP) from mixed cattle waste (solid cow dung + liquid urine) without any external chemical inputs. Basically, the natural enzymatic decomposition of urea by urease present in the waste subsequently rises the pH that converts ammonium ions to volatile ammonia gas. The resultant pure ammonia gas is collected in another tank containing phosphoric acid via air stripping process. The process is carried out continuously for 3 days to obtain a stable DAP with neutral pH, that further can be used as a fertilizer in agricultural crops. This integrated process shows its potentiality as a simple, cost-effective and energy efficient model.

Keywords: Liquid diammonium phosphate (DAP); Integrated Process; Enzymatic decomposition; Circular economy; Waste valorisation.

ICEMSET-2026/ST/1164

Traffic Flow Prediction and Signal Optimization Using AI, Machine Learning, and Deep Learning: A Systematic Review

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Abstract

Urban traffic congestion is a major challenge in growing cities, causing increased travel delays, fuel consumption, pollution, and health-related impacts. Traditional approaches, such as fixed-time traffic signals and road expansion, are often unable to respond effectively to changing traffic conditions. This review examines how Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL) are being used for traffic

prediction, signal control, and congestion management. More than 50 studies published between 2009 and 2025 are reviewed, covering methods ranging from classical models such as ARIMA and VAR to advanced Graph Neural Networks (GNNs), reinforcement learning, and IoT-based systems. The review compares their data requirements, inputs, strengths, and limitations, with particular attention to context-aware and multi-objective approaches. Six key research gaps are identified, and an integrated AI-based framework is proposed to address them and support more sustainable urban transportation.

Keywords: Traffic Flow Prediction; Traffic Signal Optimization; Graph Neural Networks; Reinforcement Learning; Spatiotemporal Analysis; Intelligent Transportation Systems (ITS); Machine Learning; Multi-Objective Optimization.

ICEMSET-2026/ST/1165

Emerging Technologies and Future Electronics: A Cross-Layer Review of Edge AI, Heterogeneous Integration, Advanced Materials, and 6G

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Abstract

Future electronics are moving beyond conventional CMOS scaling through the convergence of specialized compute, advanced packaging, novel materials, photonic interconnects, and next-generation wireless hardware. This paper reviews seven closely coupled technology directions: edge AI and RISC-V processors, computing-in-memory (CIM), neuromorphic computing, chiplet-based heterogeneous integration, two-dimensional and flexible electronics, gallium-nitride/silicon-carbide power electronics, and 6G/terahertz and silicon-photonic hardware. Recent literature indicates that performance scaling is increasingly achieved through architectural specialization and cross-layer integration rather than transistor scaling alone. RISC-V customization and reconfigurable accelerators improve edge inference efficiency, CIM reduces data-movement overhead, neuromorphic architectures exploit event-driven computation, chiplets and 3D integration improve modularity and integration density, 2D materials extend device scaling, wide-bandgap devices improve high-frequency power conversion, and photonics/THz hardware address future bandwidth and sensing demands. The review identifies common gaps in manufacturability, thermal management, software ecosystems, standards, reliability, and benchmarking. A structured review methodology and a literature-derived scenario-suitability simulation are proposed to compare technology directions under four deployment contexts. The resulting synthesis shows that future electronics should be evaluated using multi-dimensional metrics that include performance, energy efficiency, integration maturity, manufacturing readiness, and application flexibility.

Keywords: Future electronics, Edge AI, RISC-V, Computing-in-memory, Neuromorphic computing, Chiplets, 2D Electronics, GaN, SiC, 6G, Terahertz, Silicon Photonics.

ICEMSET-2026/ST/1166

Investigation on piezoresistive properties of reduced graphene oxide-treated glass textile-based multifunctional sensors

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Abstract

Glass fibre-reinforced composites (GFRC) are widely used in aerospace, construction, and automotive industries. However, their anisotropic behaviour complicates damage prediction under operational loads. This study develops a multifunctional glass textile-based sensor coated with reduced graphene oxide for structural health monitoring. Electrical resistance is evaluated as a function of nanoparticle concentration and sensor geometry. Three-point bending tests investigate the piezoresistive response of sensors embedded in GFRC,

considering sensor width and placement through the composite thickness. Cyclic flexural testing further assesses sensing performance under repeated loading. The findings demonstrate the sensor's potential for damage assessment in GFRC. Additionally, the sensor can serve as an electrically conductive pathway or a resistive element in electronic textiles, with potential applications in sensing force, torque, weight, pressure, flow, and acceleration.

Keywords: Composite materials; Piezoresistive sensor: Structural health monitoring.

ICEMSET-2026/ST/1167

Design and Evaluation of a Compact 3-Element Antenna Array for High-Data-Rate IoT Communication Systems

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Abstract

The design and evaluation of a compact three element antenna array system for high data rate Internet of Things (IoT) communication system at 1-7 GHz frequency band is presented. This proposed configuration includes three parallel radiating elements, close to each other, and sharing a common feeding and ground structure, giving it the characteristics of compactness, dual-resonant operation, high efficiency and better polarization performance. The key novelty is the incorporation of a compact geometry with good resonances at 2.45 and 4.82 GHz without compromising the desired gain, cross polarization discrimination and impedance matching characteristics. The layout was optimized with DXF files and simulated and analyzed by an electromagnetic simulation program called HFSS. Simulation results show S11 values of −28.1 dB at 2.45 GHz and −25.5 dB at 4.82 GHz, with corresponding VSWR values of 1.08 and 1.11. The radiation efficiencies at the two resonances were found to be about 84% and 91% respectively and maximum radiation efficiency of about 94% at 4.82 GHz. These increases of the array were found to be 6.5 dBi and 9.0 dBi, respectively. The high polarization discrimination ratio (PXPD=22.8 dB, 29.9 dB) further confirms the effectiveness of polarization discrimination, making this polarization controller suitable for compact, high-performance IoT wireless communication applications with high broadband electromagnetic performance and easy integration.

Keywords: A compact antenna array (CAA), 3-element antenna, IoT communication, HFSS, dual-resonance, impedance matching, radiation efficiency, realized gain, cross-polarization discrimination, high-data-rate communication.

ICEMSET-2026/ST/1168

AI-Based Soil Nutrient NPK Tester and Smart Crop Recommendation

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Abstract

Agriculture productivity largely depends on soil nutrient availability, especially Nitrogen (N), Phosphorus (P), and Potassium (K). Traditional soil testing methods are timeconsuming, expensive, and not easily accessible to many farmers. This project proposes an AI-Based Soil Nutrient NPK Tester and Smart Crop Recommendation System to provide a faster and smarter solution for soil analysis. The system uses sensors to detect soil nutrient levels and collect real-time data. Artificial Intelligence and machine learning algorithms analyze the collected data to determine soil fertility. Based on the detected NPK values, the system recommends the most suitable crops for cultivation. It also provides suggestions for appropriate fertilizer usage to improve soil health. This approach helps farmers make better farming decisions based on accurate soil information. The system aims to increase crop yield, reduce fertilizer misuse, and support sustainable agriculture. Overall, this technology makes soil testing more efficient, affordable, and accessible for modern farming.

Keywords: Soil Nutrient Analysis; NPK Sensor; Artificial Intelligence; Crop Recommendation; Precision Agriculture.

ICEMSET-2026/ST/1169

Design and Development of a Globally Compatible Dual-Voltage Mobile Power Adapter for 100 V and 240 V, 50 Hz Supply System

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Abstract

In today's interconnected world, mobile devices require reliable charging solutions compatible with varying AC voltage standards. This project focuses on designing a universal mobile adapter capable of operating across an input voltage range of 100 V to 240 V while delivering a stable, regulated DC output. The proposed system employs a switched-mode power supply (SMPS) architecture, offering high efficiency, compact size, and adaptability to input voltage variations. The design incorporates AC-to-DC rectification, filtering, high-frequency switching, voltage transformation, and output regulation. High-frequency operation helps reduce power losses and minimize component size, enhancing portability and efficiency. The system also considers essential protection features, including over-voltage, over-current, and short-circuit protection, to improve safety and reliability. The proposed adapter demonstrates the feasibility of a universal charging solution compatible with different electrical standards while ensuring consistent output performance. This project provides practical insights into power electronics and efficient power conversion techniques.

Keywords: Switched-Mode Power Supply (SMPS); Universal Mobile Adapter; DC-DC buck converter; Pulse Width Modulation (PWM).

ICEMSET-2026/ST/1170

Eco-Friendly Synthesis of Nickel Oxide Nanoparticles for Efficient Photocatalytic Degradation of Methylene Blue

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Abstract

The contamination of aquatic environment by synthetic dye pollutants demands sustainable, cost-effective wastewater treatment strategies. In this study, nickel oxide (NiO) nanoparticles were synthesized via an eco-friendly green route using black tea extract as a natural reducing and capping agent. The synthesized nanomaterials were comprehensively characterized using UV–Visible spectroscopy, X-ray diffraction, Fourier-transform infrared spectroscopy, and Scanning Electron Microscopy to evaluate their optical, structural, chemical, and morphological properties. Photocatalytic performance was evaluated through the degradation of methylene blue dye under sunlight over 60 minutes, monitored systematically at periodic intervals. The role of pH in the photocatalytic degradation was also studied. Further nickel oxide–carbon (NiO–C) composite was prepared which had superior dye degradation efficiency compared to bare NiO nanoparticles. This notable enhancement was attributed to synergistic effect that improves surface area and charge transfer dynamics in the composite material. Consequently, green-synthesized NiO and its composite provides an efficient, sustainable photocatalytic alternative for environmental wastewater remediation.

Keywords: Green synthesis, Black tea extract, Nickel oxide nanoparticles, NiO–C composite, Photocatalytic degradation.

Waste to Resource Approach: Synthesis and characterization of Sawdust-Derived biochar Co-Doped with N/Fe for Simultaneous Removal of Multi-Heavy Metal from Wastewater

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Abstract

Wood-processing residues represent an abundant biomass resource with significant potential for sustainable environmental applications within a circular economy framework. Among these, sawdust has emerged as eco-friendly and cost-effective, promising precursors for heavy metal remediation in wastewater; however, the understanding of how adsorption performance and mechanisms in multi-metal systems remains limited. In this study, a sawdust-derived nitrogen/iron co-doped biochar (SN-Fe@BC) was successfully synthesized through a one-step pyrolysis approach using sawdust as the carbon precursor, urea as the nitrogen source, and $FeCl_3 \cdot 6H_2O$ as the iron source. The synthesized biochar was evaluated for the simultaneous removal of Cr, Ni, Cu, and Cd ions from aqueous solutions. Comprehensive characterization using SEM, BET, FTIR, XRD, and XPS analyses confirmed the successful incorporation of nitrogen and iron functionalities into the porous carbon matrix. The prepared SN-Fe@BC exhibited a rough porous structure with a high specific surface area of 340.77 m^2/g, providing abundant active adsorption sites. Adsorption equilibrium was achieved within 30–40 min and followed pseudo-second-order kinetics for Ni,Cu anf Cd indicating chemisorption-dominated interactions. Regeneration studies demonstrated good reusability over multiple adsorption–desorption cycles. Mechanistic investigations indicated that the removal process involved synergistic interactions including surface complexation, electrostatic attraction, ion exchange, cation–π interaction, and Fe–N active-site coordination. The study demonstrates a sustainable waste-to-resource strategy for converting biomass residues into high-performance adsorbents for wastewater remediation, contributing to circular economy practices and sustainable environmental management pathways relevant to Africa's development.

Keywords: Biochar, Sawdust, Heavy metals, Sustainable material, Adsorption.

Explainable AI for Critical Infrastructure Threat Detection: Integrating SHAP, LIME, and Counterfactual Reasoning for Trustworthy Security Operations

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Abstract

Machine-learning intrusion detectors are increasingly used to defend critical infrastructure (CI), yet their opacity limits operator trust, auditability, and regulatory acceptance. This paper presents XAI-CI, a modular framework that embeds three complementary explanation methods, namely SHAP, LIME, and counterfactual reasoning, into an ensemble-based detection pipeline and fuses them into one tiered view for security operations centre (SOC) analysts. We describe latency-aware engineering measures (offline global SHAP, deterministic LIME, constrained counterfactual search, caching, and edge-cloud placement) and map the resulting explanation artefacts to obligations under the EU AI Act, GDPR Article 22, the NIST AI RMF, and ISO/IEC 27001:2022. Experiments on NSL-KDD, UNSW-NB15, and CIC-IDS2017 report detection accuracy above 98% for every explained model and a mean explanation latency of 445 ms per alert; a 47-analyst study indicates 37% shorter triage time than with unexplained alerts. We close with limitations, chiefly the IT-network character of public benchmarks, and a research agenda for trustworthy AI in CI security operations.

Keywords: Explainable AI, Critical Infrastructure, Intrusion Detection, SHAP, LIME, Counterfactual Explanations, Regulatory Compliance, Human - AI trust.

ICEMSET-2026/ST/1173

Sustainable Textile Solutions for Thermal Insulation: A Review

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Abstract

Fossil-fuel-based insulation materials such as fibreglass, polystyrene, and polyurethane foam constitute an alarming threat to the environment. These challenges encouraged researchers working in textiles to explore environmentally friendly fibre-based alternatives with low thermal conductivity and the capability to be either biodegradable or recycled. This review highlights recent trends in sustainable thermal insulation textiles. The paper focuses on three major topics: heat transfer in porous textiles, factors that affect thermal performance, and sustainable materials that replace traditional insulation. It discusses natural and regenerated cellulosic fibres such as wool, bamboo, hemp, and lyocell, as well as recycled PET and post-consumer polyester-cotton blend fibres. These materials typically have a lower thermal conductivity of 0.03 to 0.07 W/m·K, making their insulating performance comparable to that of conventional petroleum-based insulating materials. New aerogel-based textile composites and biopolymer-reinforced materials further improve the thermal insulation performance of sustainable textiles. For example, silica aerogel coatings can achieve low thermal conductivity, reaching values as low as 0.013 W/m·K. At the same time, they remain flexible enough for use in technical textiles and clothing. The review also highlights that materials made from agricultural and textile waste provide a practical way to reduce environmental footprint while maintaining high thermal insulation performance. Still, there are gaps in long-term durability testing, standardised comparative methodologies, and scalable production of bio-based aerogels. These offer clear potential for further experimental and practical exploration in this arena.

Keywords: Sustainable thermal insulation, thermal conductivity, natural fibre insulation, bio-based fibres, recycled polyester (rPET), aerogel textile composites, circular economy textiles.

ICEMSET-2026/ST/1174

Financial, Feasibility and Sensitivity Analysis of Hybrid Solar-Wind Renewable Energy Systems

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Abstract

The increasing demand for reliable and cost-effective renewable energy has increased interest in hybrid solar–wind renewable energy systems (HRES). In this paper the energy feasibility, economic viability and parametric sensitivity of a hybrid solar–wind system are assessed with representative 24 h irradiance, wind-speed and load profiles annualized to estimate long term performance. Photovoltaic and wind power generation is modeled using key system parameters while energy supply, excess energy, unmet load, renewable fraction and major economic indicators are evaluated. For a PV of 3.00 kW and a wind of 1.16 kW configuration the system produces 14.19 kWh/day (10.80 kWh/day from PV; 3.39 kWh/day from wind) or 5178.23 kWh/year. No excess energy exists but annual unmet energy is 38,621.77 kWh which represents an 88.18% unmet load and 11.82% renewable fraction. The total investment is INR 273,101.73; annual O&M costs are INR 4,562.03 and net annual savings INR 36,863.79. The system has a payback period of 7.41 years (LCOE INR 6.2527/kWh), ROI 169.96%, NPV positive (INR 88,832.38). However, the high unmet demand makes it overall energy infeasible even though economic performance is good. Sensitivity analysis shows that NPV increases with PV area beyond 25 m² (returns diminish), decreases with turbine diameter, and declines sharply as discount rate increases. PV area around 20–25 m² is a reasonable compromise between investment and economics. Renewable capacity should be increased and grid or backup integration required to increase reliability and demand coverage.

Keywords: Solar Photovoltaic (PV), Hybrid Solar-Wind Renewable Energy Systems, Total Harmonic Distortion (THD), Harmonic Analysis, Buck Converter.

ICEMSET-2026/ST/1175

Framework and design of an Explosion protection suit for defense application and related implications

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Abstract

Statically close to 80,000 to over 100,000 combatants and individuals die globally each year due to active armed conflicts and state-level and unexploded ordnance and landmines globally kill or injure between 15,000 and 20,000 people every year, with roughly 80% of those casualties being civilians rather than active soldiers. The upsurge of industrial market in warfare equipments and associated deep-tech is highly competitive and is increasingly driven by the need to develop new technologies for the welfare of soldiers. This competitiveness has led the defence industry to rely on creating comfortable, safer and low maintenance equipments. Fundamentally, soldiers are required to protect themselves from potential cases viz., Hand to hand combat, bullet fires, heavy artillery, chemical warfare including the nuclear weapons, incessantly resistant to firing and explosions. Which is an aspect that demands enhanced attention and technological development rather than relying on conventional suits for fulfilling purpose at the cost of safety. Scientifically, an explosion is a sudden oxidation or decomposition reaction proceeding at a high reaction rate, which produces an increase in temperature or pressure or both at the same time. The statutory definitions of explosion protection derived from the health and safety at work regulations are concerned with workplaces. For this reason, explosion protection is generally limited to description of reactions with oxygen in the air. Oxidation reactions normally involve increases in heat and pressure and therefore fulfil the criteria of an explosion. Alongside, protection from continous bullet firing is necessitated largely in war like situations prominently. The uniform utilized is more formal and unprotective for any human guarding the border. In this perspective, the development of the explosion protection suit system is deeply analyzed along with recent advances and selected improvement in the last 5 decades alongside related technological advances. With proper literature survey, the present work detail investigations on the explosion protection safety and its innovations worldwide. The work is motivated by the inevitability of a novel design of ultra-modern explosion protection suit, primarily meant for defence application. The specific objectives of the study are to analyze the operating structure, governing dynamics and material specialty of the different protection suit systems, the advantages and disadvantages, their level of mechanization, the interaction between man and machine in the situation of the combat and the systemic structures / materials that can be used in the development of fully autonomous explosion protection suit. The design is likely to provide enhanced control time management, integrated protection, proactive planning and resource allocation for soldiers for enhanced safety.

ICEMSET-2026/ST/1176

Structural Investigation of CCTO Based Composites

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Abstract

CCTO-based composites incorporating 0.1 wt.% multi-walled carbon nanotubes (MWCNTs) were prepared using pristine and modified CCTO as host matrices. The host materials were synthesized using solid-state reaction method and MWCNTs was incorporated through ultrasonication for homogeneous dispersion and then sintered at 1040 °C for 3 h in a muffle furnace under an ambient air atmosphere. XRD analysis was performed to confirm the crystalline phases of the prepared composites. Raman spectroscopy revealed characteristic vibrational modes of CCTO in the low-frequency region, while the higher-frequency region exhibited the D and G bands associated with the carbon nanotubes. Additional spectral features suggest the possible contribution of multi phonon raman modes or interactions among vibrational modes in the composite systems. FTIR spectroscopy was also employed to investigate the characteristic vibrational bonds and chemical bonding

features of the composites. This comparative investigation provides insight into the structural and vibrational characteristics of MWCNT-incorporated CCTO based composites.

Keywords: CCTO Ceramics, Ceramic Composites, XRD, Raman Spectroscopy.

ICEMSET-2026/ST/1177

QR-iShield: An Intelligent URL Reputation and Automated Risk Classification System for UPI-based QR Code Phishing Detection

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Abstract

QR codes have become a common type of mobile payments in India, and this technology has been misused by quishing attacks that redirect victims to malware without exposing a clickable link for inspection. QR-iShield is a application designed around four detection layers, of which two are functional at the current moment. The paper reports on those completed components, which are a URL reputation engine that combines domain-age, TLS-certificate, and typosquatting-blacklist signals into a weighted score, achieving approximately 90 percent verdict accuracy on a manually curated test set of safe and malicious URLs; and an automated URL risk-classification module, developed independently. At this stage the reputation engine takes a URL as manual input rather than extracting it from a scanned QR code, since the backend-integration pipeline has not yet been built. Overall, the design and measured accuracy of the reputation engine has been described and summarized along with the risk-classification module.

Keywords: QR code phishing; quishing; URL reputation; phishing detection; mobile security; WHOIS; risk classification.

ICEMSET-2026/ST/1178

Green Synthesis, Physicochemical Characterization and Evaluation of Antibacterial Properties of Copper Oxide Nanoparticles

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Abstract

Nanotechnology is a waste area of research and immense potential to revolutionize the biological field. The present study focuses on the synthesis method, characterization, and antibacterial action of the Copper oxide nanoparticles. Copper oxide nanoparticles were synthesized from the leaf extract of the *Syzygium cumini* plant. Nanoparticles were charachterized by using techniques including Fourier Transform Infrared (FTIR) Spectroscopy, UV- visible spectroscopy, zeta potential that confirmed the formation and stability of nanoparticles. The action of the nanoparticles was analysed on Gram-positive bacteria, *Staphylococcus aureus* and Gram-negative bacteria, *Escherichia coli*. The nanoparticles showed significant antibacterial action and results were observed with Disc diffusion method. The minimum inhibitory concentration for *Escherichia coli* was noted with copper oxide nanoparticles as (1.035±4.7)µg/ml and (120.4±8.16)µg/ml for Staphylococcus *aureus* respectively. Thus, it can be concluded the ecofriendly, cost effectively synthesized copper oxide nanomaterials have significant impact on bacterial activity.

Keywords: Nanoparticles, copper oxide, spectroscopy, antibacterial, green synthesis.

ICEMSET-2026/ST/1179

CouncilMed: A Multi-Model, Agent-Assisted Framework for Consensus-Driven Medical Image Diagnosis

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Abstract

Many AI-based medical image diagnostic tools upload images to cloud servers, raising concerns about patient privacy, network latency, and dependence on centralized infrastructure. This paper presents CouncilMed, a web-based framework that runs medical-image inference locally in the browser for MRI, CT, and X-ray inputs. The proposed pipeline combines DenseNet-121 for classification, Attention U-Net for lesion localization, and Swin-UNETR for volumetric segmentation through a weighted consensus mechanism. Computation is delegated to Web Workers to keep the interface responsive during analysis and three-dimensional visualization. Because processing remains within the browser, sensitive images need not be transmitted to an external server. The classification branch achieved approximately 87.98% accuracy on a held-out brain-tumor MRI test set. CouncilMed explores how current web technologies can support privacy-aware medical AI on local devices, although performance depends on users' hardware and clinical validation is still required.

Keywords: Medical Imaging; Ensemble Learning; Client-Side Inference; Privacy-Preserving Computing; Web Workers.

ICEMSET-2026/ST/1180

Recent Advances in Sustainable Gypsum-Based Drywall and Partition Wall Systems

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Abstract

The drywall system has become a widely accepted non-structural building solution due to its lightness, fastness, low cost, multifunctionality and versatility. Alongside the focus on environmental sustainability, the demand of a reduced carbon footprint, sustainable use of materials and lesser resource depletion has resulted in the evolution of bio-based gypsum composites made from agricultural by-products and other renewable resource to substitute the conventional drywalls. This review critically evaluates drywall systems with regards to their evolution history, taxonomy, material composition, fabrication techniques and engineering performance. The study examines and compares mechanical properties, thermal, acoustic, fire resistance and durability aspects of conventional and advanced drywall assemblies, as well as experimental testing, material characterization and relevant building standards. It also reviews recent advancements made in sustainable drywall technologies, bio-based reinforcing materials and enhanced composite drywall systems, and further presents comparative evaluation of reinforcement options, challenges, research needs and prospective directions for further investigation. In its integration of cutting-edge developments made in the field of material engineering, structural performance and sustainability, this review serves as a complete reference to the community of researchers, engineers, manufacturers and practitioners engaged in building-oriented innovations in drywall systems for the new resilient, energy efficient and environment friendly structures.

Keywords: Drywall systems; Gypsum board; Steel stud partitions; Composite materials; Sustainability.

ICEMSET-2026/ST/1181

AI-Based Dress Code and Facial Feature Detection for Attendance Management

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Abstract

Manual monitoring of student attendance and dress-code compliance is time-consuming and difficult to sustain in large institutions. This paper presents an AI-based system that combines student identification, attendance monitoring, dress-code classification, and grooming detection within a single framework. ArcFace is used to recognize registered students, a Vision Transformer (ViT) classifies attire as formal or informal, and a ResNet-18 classifier detects beard presence. The dress-code and grooming datasets contain 2,561 and 1,608 images, respectively. In preliminary evaluation, the ViT model achieved 92.5% test accuracy and the ResNet-18 model achieved 95.98% test accuracy, while face recognition remained reliable up to approximately 5 m in real-world conditions. The results indicate that the proposed approach can reduce manual effort in student monitoring and support consistent, automated compliance tracking.

Keywords: ArcFace, Vision Transformer, ResNet-18, Dress-Code Classification, Automated Attendance.

ICEMSET-2026/ST/1182

A Proposed Technique for Making Frequency Modulation Circuit Which is Actually a Colpitts Oscillator and Making both Tx And Rx Using Hartley Oscillator

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Abstract

Initially, the FM Transmitter Circuit was made by Colpitts oscillator and it followed barkhausen criteria. FM transmitter circuit requires Mic, audio pre-amplifier, Modulator oscillator, RF amplifier and Antenna. In this paper, I have used colpitts oscillator to make FM Tx.

ICEMSET-2026/ST/1183

Control of a Four-Port DCDC Converter for Photovoltaic Systems Integrating Batteries and Supercapacitors

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Abstract

PV systems are making more and more inroads into today's power systems; more sophisticated power conversion architectures will be needed to ensure that PV power systems are able to operate under intermittent PV generation and dynamic load conditions. In this paper, a new Quad-Port Interleaved Coupled-Inductor Switched-Capacitor DC-DC Converter (QICSC-4P) for Photovoltaic (PV) systems is proposed for PV systems with battery and supercapacitor energy storage. In order to actively deliver high voltage and low input-current ripple, and coordinate the four-port power transfer, an interleaved coupled inductor network and a switched-capacitor voltage-boosting unit can be integrated to form the desired topology. A PV energy management controller is used for the control of PV power extraction, battery-charging and discharging, supercapacitor transient compensation, and DC-link voltage stabilization. Multiple operating modes of the converter are implemented: solar to load, solar to battery, solar to load through the supercap, and bidirectional solar-power storage exchange with the load. Semiconductor voltage stress and battery current fluctuation are reduced, and the dynamic response improved through coordinated modulation in duty cycle, and through adaptive current sharing. It is tested with MATLAB/Simulink for different conditions of irradiance, load disturbances, and state of charge (Soc) of the storage. The proposed architecture is compared to state-of-the-art approaches by means of performance evaluation based on voltage conversion ratio, conversion efficiency, current ripple, settling time, and power-sharing accuracy of the modules, showing that its performance is suitable for renewable-energy microgrids and hybrid energy storage applications.

Keywords: Switching capacitor, interleaved coupled inductor, PV system, multiport DC–DC converter, hybrid energy storage.

ICEMSET-2026/ST/1184

AI-Assisted Discovery of Potential FGFR1-Targeted Candidates for Systemic Sclerosis–Associated Interstitial Lung Disease

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Abstract

Systemic sclerosis-associated interstitial lung disease (SSc-ILD) is characterized by progressive pulmonary fibrosis and declining lung function. This study explored an artificial intelligence (AI)-assisted virtual-screening approach to identify potential small-molecule candidates for SSc-ILD, by using nintedanib as the reference drug. AI-generated ligands using WADDAICA tool were evaluated with SwissADME and ADMETlab 3.0 to predict physicochemical, pharmacokinetic, and toxicity-related properties. ADMET screening shortlisted four candidates (M1–M4) for further investigation and excluded M5. Molecular docking was performed using AutoDock 4.2.6 against fibroblast growth factor receptor 1 (FGFR1; PDB ID: 5A4C). Docking analysis yielded binding energies of −7.82 kcal/mol for nintedanib reference drug and -8.71 kcal/mol for M1 (methyl 4-[2-[(4-fluorophenyl){4-[methyl(2-morpholin-4-ylacetamido)amino]phenyl}methylidene]-3-hydroxy-1H-indol-6-yl]benzoate), indicating that M1 has demonstrated potential binding than the reference drug. This study demonstrates the potential of integrating AI-assisted ligand generation, ADMET prediction, and molecular docking for early-stage SSc-ILD drug discovery. Further computational optimization and experimental validation are required to establish the candidates' efficacy and safety.

Keywords: SSc-ILD; virtual screening; ADMET; molecular docking; FGFR1.

ICEMSET-2026/ST/1185

Analyzing Cooperative Spectrum Sensing Using Machine Learning for Cognitive Radio Networks

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Abstract

Wireless devices are multiplying rapidly while usable radio spectrum remains scarce. Cognitive radio eases this shortage by letting secondary users occupy bands that licensed users are not using, which demands dependable spectrum sensing. This paper presents a machine-learning-assisted cooperative sensing framework that combines short-time Fourier transform (STFT) analysis, a convolutional neural network (CNN), an RTL-SDR software-defined radio front end, and fusion of decisions from three sensing nodes. Complex I/Q samples are converted into 64×64 spectrograms and classified as AM, FM, BPSK, or QPSK by a four-block CNN. Simulations across eleven SNR levels from −20 dB to +20 dB show accuracy exceeding 90% at −4 dB and peaking at 95.45% at high SNR. At −10 dB, OR-rule fusion raises the detection probability from 0.68 for a single node to 0.94, demonstrating the benefit of spatial diversity.

Keywords: Cognitive radio; Cooperative spectrum sensing; Machine learning; Convolutional neural network; RTL-SDR.

ICEMSET-2026/ST/1186

Binder-Free In-Situ Hydrothermal Growth of NiO Thin Films on FTO Substrates for Smart Electrochromic Supercapacitor Electrodes

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Abstract

This work focuses on the binder-free fabrication of nickel oxide (NiO) thin films directly on fluorine-doped tin oxide (FTO) substrates for multifunctional electrochromic and supercapacitor applications. NiO thin films were synthesized using a single-step in-situ hydrothermal method, in which the FTO substrate was directly immersed in an aqueous reaction bath containing the nickel precursor. This approach enables simultaneous nucleation and growth of NiO nanostructures on the FTO surface without the use of binders or additional powder-processing steps. The synthesized films were characterized using X-ray diffraction (XRD), field-emission scanning electron microscopy (FESEM), and Fourier-transform infrared (FTIR) spectroscopy. XRD confirmed the formation of phase-pure cubic NiO, while FESEM revealed a uniform nanostructured morphology favourable for electrolyte penetration. FTIR confirmed the characteristic Ni–O vibrational modes. The direct growth of NiO provides strong adhesion and intimate electrical contact with the FTO substrate, facilitating efficient charge transfer. The developed method is simple, cost-effective, and scalable, offering a promising route for the fabrication of NiO/FTO electrodes for smart electrochromic supercapacitor devices.

Keywords: NiO thin film; in-situ hydrothermal synthesis; FTO substrate; nanostructured electrode; electrochromic supercapacitor.

ICEMSET-2026/ST/1187

Synthesis and Characterization of ZnO–Duckweed Biochar Composites for Photocatalytic Degradation of Doxycycline

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Abstract

This study reports the synthesis and photocatalytic performance of a zinc oxide/duckweed-derived biochar (ZnO/BC) composite for doxycycline degradation in water. The prepared materials were characterized using FTIR, XRD, TGA, SEM, and UV–Vis spectroscopy. FTIR confirmed the interaction between ZnO and the biochar matrix, while XRD verified the crystalline ZnO phase. TGA demonstrated good thermal stability, and SEM revealed well-dispersed ZnO particles on the porous biochar surface. UV–Vis analysis showed that the ZnO/BC composite possessed a suitable band-gap energy, supporting effective photocatalytic activity. The 2:1 ZnO/biochar ratio exhibited the highest degradation performance, achieving 78.55% doxycycline removal within 120 minutes under optimal conditions of pH 7, 5 mg catalyst dosage, and 70 mg/L doxycycline concentration. The enhanced activity is attributed to improved charge transfer, reduced electron–hole recombination, and the synergistic effects of ZnO and biochar, demonstrating its potential for sustainable pharmaceutical wastewater remediation.

Keywords: Zinc oxide; Duckweed biochar; Doxycycline; Photodegradation.

ICEMSET-2026/ST/1188

Pre-CVE Supply Chain Security and Continuous Integration/Continuous Deployment Remediation

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Abstract

Modern software relies on many open-source packages, and most security tools warn only after a weakness has been publicly reported. We built SentinelAI, a platform that tries to warn earlier. It combines fourteen weighted warning signs, such as a sudden change of package owner or code that runs at install time, into one Pre-CVE score. A deployment gate uses this score, a vulnerability scan and two further scores to approve or block a build in Jenkins. In a small test, the score ranked 21 packages with past incidents above 14 ordinary ones (AUC 0.88). The gate approved three clean projects and blocked three deliberately vulnerable ones. For failed builds, a retrieval-based assistant finds similar past failures and suggests fixes. Hybrid search found nearly all relevant cases, but it did not improve root-cause accuracy over the language model alone.

Keywords: Software supply chain security; Pre-CVE risk scoring; CI/CD deployment gate; Dependency vulnerability scanning; Retrieval-augmented generation.

ICEMSET-2026/ST/1189

ADD++: AI Virtual Try-On and Personal Stylist for Intelligent Fashion E-Commerce

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Abstract

Online fashion shopping provides a convenient way to explore a large variety of products, but customers often have difficulty judging how a garment will appear on their own body, whether its colour complements their appearance, and how the garment looks from different viewpoints. ADD++ is a full-stack intelligent fashion e-commerce platform developed to address these problems by combining AI-based virtual try-on, personalized colour-based recommendations, image-to-3D reconstruction, and conventional shopping functionality in one system. The application uses a React and TypeScript frontend, a FastAPI backend, PostgreSQL for persistent data, and Cloudinary for image storage and delivery. CatVTON is used as the primary virtual try-on model, with IDM-VTON and OOTDiffusion available as fallback services. The system automatically determines garment type, performs skin-tone and undertone analysis, recommends suitable products, and generates interactive 3D representations using TRELLIS. The platform additionally provides catalog browsing, cart management, checkout, order tracking, and retailer-side catalog and order management. Experimental evaluation recorded 80% accuracy for rule-based garment classification on 49 manually labelled images, successful matching of all 190 upgraded catalog images, three tops and three bottoms without repetition in recommendation tests, and cached 3D response times of 0.1–1.4 s. A lower-body OOTDiffusion try-on test fitted a skirt correctly in 18 s. The results demonstrate the feasibility of integrating multiple AI services into an e-commerce workflow while also identifying practical limitations related to GPU availability, single-pose try-on, generated 3D viewpoints, and the current colour-focused recommendation strategy.

Keywords: Virtual Try-On, CatVTON, Generative AI, Fashion Recommendation, Image-to-3D, TRELLIS, FastAPI, React, Fashion E-Commerce.

ICEMSET-2026/ST/1190

RANSOM-TRACE: A Pre-Execution Hybrid Framework for Explainable Ransomware Detection and Automated Isolation

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Abstract

The ransomware greatly disrupts the infrastructure of organizations, and conventional signature-based as well as opaque machine learning defence methods are ineffective against polymorphic zero-days. We are introducing a pre-execution framework which combines 26 static Portable Executable features, an XGBoost classifier, rule-based ransomware attribution, local SHAP explainability, and permission-stripping quarantine. When tested on chronologically ordered splits from the EMBER 2024 dataset in order to avoid temporal leakage, our model reaches an accuracy of 95.72% and ROC-AUC of 99.08%, thus offering an interpretable, end-to-end defence that eliminates threats before they are executed.

Keywords: Ransomware, Pre-execution framework, Portable Executable, XGBoost, SHAP explainability.

ICEMSET-2026/ST/1191

Simulation-Based Assessment of Load-Dependent State of Charge Estimation Accuracy in Lithium-Ion Batteries Using an Adaptive Extended Kalman Filter

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Abstract

Accurate State of Charge (SOC) estimation is central to the safe, efficient, and durable operation of lithium-ion battery systems in electric vehicles, grid storage, and portable electronics. Because SOC cannot be measured directly, it must be inferred from terminal voltage and current, and the quality of that inference depends strongly on how the battery is loaded. This study examines how different load profiles affect the accuracy of SOC estimation when an Adaptive Extended Kalman Filter (AEKF) is used. A second-order equivalent circuit model (ECM) is built in MATLAB/Simulink to represent the nonlinear open-circuit voltage behavior, ohmic resistance, and polarization dynamics of the cell. The AEKF is formulated to update the process and measurement noise covariances online from the innovation sequence. This lets the filter adjust to changing operating conditions without manual retuning. The estimator is evaluated under constant-current discharge at several C-rates, pulse loading, and dynamic drive-cycle profiles (such as UDDS and WLTP). Performance is quantified with root mean square error (RMSE), mean absolute error (MAE), maximum error, and convergence time after an initial SOC mismatch. The AEKF is also compared with a conventional EKF with fixed covariances. The simulation results indicate that estimation error is clearly load-dependent. Errors grow as current magnitude and its rate of change increase, mainly because of unmodeled polarization effects and a lower signal-to-noise ratio. The adaptive mechanism reduces this degradation and gives faster convergence and better robustness than the fixed-covariance EKF under demanding dynamic conditions. These findings help identify the operating regimes where SOC estimation is most vulnerable and offer practical guidance for tuning estimators in battery management systems (BMS).

Keywords: Lithium-ion battery; State of Charge; Adaptive Extended Kalman Filter; Equivalent circuit model; Load dependency; Battery management system; Simulation.

ICEMSET-2026/ST/1192

Structural, Dielectric and Impedance Studies of Magnetised Acacia Gum–CuO–Graphene Oxide Nanocomposite for Energy-Storage Applications

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Abstract

A magnetised acacia gum–copper oxide–graphene oxide (MAG–CuO–GO) nanocomposite is investigated as a potential multifunctional material for dielectric energy-storage applications. Structural and chemical characterisation using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR) and Raman spectroscopy, together with vibrating-sample magnetometry (VSM), can elucidate its phase structure, surface functional groups, carbon framework and magnetic response. Frequency- and temperature-dependent electrical measurements were examined over approximately 1 Hz–10 MHz and 293.3–372.7 K. The plots show a pronounced decrease in capacitance and real permittivity with increasing frequency, while the imaginary permittivity and dielectric-loss response are strongest at low frequencies. The real AC conductivity generally increases toward high frequencies, whereas the real impedance decreases substantially with frequency. These trends are consistent with frequency-dependent polarisation and charge-transport processes in a heterogeneous composite. The combined structural, magnetic and electrical investigation provides a basis for assessing MAG–CuO–GO for capacitive energy-storage and related electronic applications.

Keywords: Magnetised acacia gum; Copper oxide; Graphene oxide; Dielectric properties; Impedance spectroscopy.

ICEMSET-2026/ST/1193

Effect of Ba Doping on Photocatalytic and Supercapacitor Performance of NiO Nanoparticles

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Abstract

In this study, undoped and barium-doped nickel oxide (Ba-NiO) nanoparticles were green-synthesised using *Morinda Tinctoria* extract. We investigated the structural, optical, chemical composition, supercapacitance and photocatalytic properties of Ba-NiO nanoparticles for doping percentages of 0 to 6. The structure and morphology of the pure and Ba-NiO nanoparticles were studied using X-ray diffraction (XRD) and scanning electron microscopy (SEM) analysis. XRD patterns reveal the face-centred cubic structure of NiO, with the substitutional doping of Ba in Ni sites. The average crystallite size decreases from 16.3 to 12.3 nm with the increase in Ba doping percentage up to 4% doping and then increases again. The SEM micrographs confirm a spherical shape and nanoform of Ba-NiO nanoparticles, with particle size decreasing from 30 nm for undoped to 21 nm for 4% Ba-NiO. Optical properties were observed using UV-Vis absorbance spectra, and the optical band gap was found to be tunable with doping. The elemental composition analysis was carried out using energy-dispersive X-ray analysis (EDAX), and the results matched the Ba doping percentage. The functional groups and chemical bonds present in the samples were studied using Fourier transform infrared (FTIR) spectra. The specific capacitance and the area of the CV loop increased with increasing doping concentration, reaching a maximum at 4%. The photocatalytic properties of the Ba-NiO nanoparticles were investigated for Methyl Violet (MV) dye under sunlight illumination. The photocatalytic efficiency of NiO is enhanced upon doping with Ba, and 100% photodegradation of MV dye is observed after 100 min of sunlight irradiation with 4% Ba-NiO nanoparticles.

Keywords: Nanoparticles, Green synthesis, Photocatalysis, Methyl violet, Supercapacitor.

ICEMSET-2026/ST/1194

Numerical Modelling of a Wool-FEP Lateral-Sliding Triboelectric Nanogenerator with Synchronized Energy Extraction

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Abstract

Triboelectric Nanogenerators (TENGs) are novel possibilities for mechanical energy harvesting in wearable and self-powered applications. This work develops a MATLAB based framework of theory for a lateral sliding TENG made of wool fluorinated ethylene propylene combining displacement dependent electrostatic behaviour with time domain circuit dynamics. Under continuous resistive loading and synchronized extraction this model estimates voltage, transfer charge, energy extraction, and electromechanical efficiency. For a 15 × 15 mm^2 device with a maximum transfer charge of 1.9125 nC and a predicted peak Voc of 3169.35 V, synchronized extraction produces 3.38839 μJ per cycle, but the optimized continuous load setup produces 0.523638 μJ. The equivalent idealized efficiencies are 97.37 % & 15.69 % respectively. The findings suggest that load matching & electrical synchronization may have a major impact on energy usage. Because the surface charge density is a model input rather than a measured device specific value experimental validation must be performed to verify practical performance.

Keywords: Wool-FEP, lateral-sliding, synchronized switching, RC dynamics, Triboelectric Nanogenerator.

ICEMSET-2026/ST/1195

Development of Fe_2O_3/Duckweed Biochar Composite for Photocatalytic Degradation of Doxycycline in Aqueous Systems

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Abstract

This study reports the synthesis and photocatalytic performance of an iron (III) oxide/duckweed-derived biochar (Fe_2O_3/BC) composite for doxycycline degradation in water. The materials were characterized using Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM-EDX), and ultraviolet-visible (UV–Vis) spectroscopy to examine their functional groups, crystalline structure, morphology, elemental composition, and optical properties. The 2:1 Fe_2O_3/BC ratio exhibited the highest degradation performance, achieving approximately 30% doxycycline removal after 120 minutes, with a rate constant of 0.00276 min^{-1}. Increasing the catalyst dosage to 30 mg improved degradation to approximately 42% after 150 minutes. Under alkaline conditions (pH 10.87), approximately 90% doxycycline removal was achieved after 150 minutes using 30 mg catalyst and an initial doxycycline concentration of 50 mg/L. Scavenger experiments identified superoxide radicals as the dominant reactive species. These findings highlight the composite's potential for sustainable pharmaceutical wastewater treatment.

Keywords: Doxycycline, Fe_2O_3/BC, photocatalysis, photocatalytic degradation.

ICEMSET-2026/ST/1196

CouncilMed: A Multi-Model, Agent-Assisted Framework for Consensus-Driven Medical Image Diagnosis

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Abstract

Many AI-based medical image diagnostic tools upload images to cloud servers, raising concerns about patient privacy, network latency, and dependence on centralized infrastructure. This paper presents CouncilMed, a web-based framework that runs medical-image inference locally in the browser for MRI, CT, and X-ray inputs. The proposed pipeline combines DenseNet-121 for classification, Attention U-Net for lesion localization, and Swin-UNETR for volumetric segmentation through a weighted consensus mechanism. Computation is delegated to Web Workers to keep the interface responsive during analysis and three-dimensional visualization. Because processing remains within the browser, sensitive images need not be transmitted to an external server. The classification branch achieved approximately 87.98% accuracy on a held-out brain-tumor MRI test set. CouncilMed explores how current web technologies can support privacy-aware medical AI on local devices, although performance depends on users' hardware and clinical validation is still required.

Keywords: Medical Imaging; Ensemble Learning; Client-Side Inference; Privacy-Preserving Computing; Web Workers.

ICEMSET-2026/ST/1197

Design and Development of an AI-Enabled Sustainable Cotton Cultivation

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Abstract

Cotton harvesting is labour-intensive, and conventional methods often mix mature, immature, and damaged cotton, reducing cotton quality. This study presents CottonAI, a low-cost, solar-assisted robotic system for selective cotton harvesting, impurity removal, and digital yield management. The system uses a camera-based vision module to classify cotton bolls based on colour and size, a servo-controlled robotic arm for selective plucking, and a conveyor-based mechanism with splitting and filtering units to remove leaves, stems, and dust. A 12 V, 12 Ah battery supported by a 20 W solar panel provides power to the system. A web-based application enables yield recording, production monitoring, and invoice generation. Functional testing demonstrated the coordinated operation of the detection, plucking, filtering, collection, and monitoring modules. However, performance was affected by lighting conditions and cotton boll positioning. The prototype was developed at a cost of ₹34,100, demonstrating the feasibility of integrating harvesting, cleaning, and digital record management into an affordable platform for small and marginal farmers. Further quantitative field testing is required to establish detection accuracy, harvesting throughput, impurity removal efficiency, and energy consumption.

Keywords: Smart agriculture, artificial intelligence, computer vision, robotic harvesting, solar energy, cotton processing, digital yield management.

ICEMSET-2026/ST/1198

Novel Anode Formulation Using Petroleum Pitch and Calcined Coke

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Abstract

This research investigates, petroleum pitch as a binder for carbon anodes used in the Hall-Héroult process of aluminium production, making these anodes more environmentally friendly and sustainable. Alumina (Al_2O_3) dissolves in the molten cryolite flux at a temperature of 940 - 980 °C and is electrolysed, where the aluminium is obtained at 99.8% purity. Carbon anodes not only conduct electricity but also produce CO as they are consumed. However, they have serious energy and material issues: they require excessive energy input of 1315 kWh/kg, break due to thermal shock during baking at 1150 °C, and emit PAHs from coal tar pitch. Petcoke pitch-based anodes can emit 10 times lower PAHs than those of coal tar pitch, as petroleum pitch is a product derived from oil residues, which has a coking value of 58% of coal tar pitch, but petroleum pitch has 47%, thus

implying toxicity/emissions are halved while binding calcined coke for density/conductivity. The experimental mixture is 15g coke, 5g butt and 10g pitch, heated at 150 °C and pressed at 500 °C / 75 bar. Recycling of butts (10 – 20 % by mass, 90 – 95 % recovery) saves 510 % anode energy as it avoids the coke calcining step. Prebake anodes are superior to pollutant, heavy Soderberg types. Petcoke pitch anodes, with proper blends and production techniques for strength and size, could be a significant breakthrough for cordless, environmentally friendly smelters.

Keywords: Anode butt; Petroleum pitch; baked anodes; Electrolysis.

ICEMSET-2026/ST/1199

Evaluating Website Usability Using Large language models

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Abstract

Online patient experiences can identify safety problems in healthcare institutions. However, quality improvement requires engagement with these occurrences. Online feedback from healthcare companies provides valuable insights about corrective culture, including safety issue identification, interpretation, and reaction methods. This study tested the use of a big language model to accurately code answers for two markers of corrective culture: involvement and organisational learning. The rise of digital healthcare has led to increased patient communication and burden for healthcare providers. LLMs have the potential to provide automated solutions to patient enquiries via eHealth platforms, but their efficacy, accuracy, and limits in healthcare contexts remain a worry. This study evaluates the performance and perceived usefulness of LLMs in healthcare, with an emphasis on their assistance for clinical decision-making and patient communication. The use of large language models (LLMs) in healthcare has raised both enthusiasm and concerns due to their capacity to answer to free-text questions requiring specific professional expertise. This survey explores the existing capabilities and development process of Healthcare LLMs, providing an overview of the transition from conventional Pretrained Language Models to LLMs. Large language models (LLMs), generative AI (GAI), and generative vision models (GVMs) have Transformational technologies in healthcare, creating new landscapes for diagnostics, patient communication, and innovative research. The review summarises existing data about the accuracy and sufficiency of medical LLMs give more information in response to patient questions than healthcare practitioners or clinicalguidelines. While LLMs have potential as helpful tools in healthcare, their integration should be tackled. Be cautious due to variable performance and potential hazards. Further study is required before widespread adoption.

Keywords: Large language models (LLMs), Online Feedback, Healthcare application.

ICEMSET-2026/ST/1200

From Sensor Signals to Motor Fault Detection: An Embedded Multisensor Monitoring Approach

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Abstract

Electric motors are widely used in industrial applications, where unexpected failures can cause production downtime, increased maintenance expenses, and reduced operational reliability. Conventional maintenance practices based on periodic inspections may not identify early changes in operating conditions. To address this challenge, this study proposes a cost-effective, embedded motor condition monitoring system that integrates multiple sensing modalities to investigate the relationship between motor operating conditions and measurable physical signals. The proposed system employs an ESP32 microcontroller to acquire vibration, ambient temperature, humidity, and motor current data. An MPU6050 inertial measurement unit captures vibration-related signals, a DHT11 sensor monitors ambient temperature and humidity, and an ACS712 sensor measures motor current within its rated operating range. The collected data are transmitted to a computer through USB

serial communication or Wi-Fi, where they are time-stamped, labelled according to the corresponding operating conditions, and stored for further analysis. Experimental observations are obtained during normal motor operation and under controlled abnormal conditions. Signal-derived features are examined to identify patterns associated with changes in motor behaviour and to assess their usefulness in distinguishing healthy and faulty operating states. The proposed monitoring approach is evaluated using separately recorded test data to examine its fault discrimination capability. Particular attention is given to the contribution of individual sensor signals, the potential benefits of combining multiple measurements, and the limitations associated with low-cost sensing components. The study aims to establish an accessible framework for embedded motor condition monitoring and investigate its potential application in predictive maintenance, particularly in small and medium-sized industrial environments where affordable monitoring solutions are desirable.

Keywords: Motor Condition Monitoring, Fault Detection, Predictive Maintenance, Multisensor Data Acquisition, Embedded Systems.

ICEMSET-2026/ST/1201

Modulating Spin-States of Active Catalysts for Efficient Urea Oxidation in Anion Exchange Membrane Electrolyzer

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Abstract

The electronic properties of active M(O)OH catalysts can be effectively modified by tailoring the characteristics of their corresponding precatalysts. Herein, we report a coordination site-modulated precatalyst to access active catalysts for efficient electrocatalytic urea oxidation in an anion exchange membrane (AEM) electrolyzer. A two-dimensional NiFe-coordination polymer (NiFe-2D) was constructed via selective site engineering using hydrazine. Upon electrochemical reconstruction, NiFe- 2D was transformed into an active Fe-Ni(O)OH catalyst (AC-2D). X-ray absorption spectroscopy (XAS) confirmed the changes in the coordination and electronic environment of AC-2D with a tuned spin state. Remarkably, AC-2D delivered a current density of 100 mA cm−2 at 1.50 V vs. RHE for the oxygen evolution reaction (OER) and 1.40 V vs. RHE for the urea oxidation reaction (UOR). AC-2D also delivered outstanding performance in an AEM electrolyzer, achieving a current of 4 A at 2.9 V cell voltage and maintaining operation for over 8 days for UOR-assisted water splitting. In situ electrochemical impedance spectroscopy (EIS) and kinetic analysis suggested facile charge transfer during OER and UOR in AC-2D. In situ Raman studies revealed that Ni4 + species were identified as the main active centers for OER, while Ni3 + species served as the catalytic sites for UOR.

Keywords: Coordination polymer; metal-(oxy)hydroxide; site selective engineering; spin-state tuning; urea oxidation reaction.

ICEMSET-2026/ST/1202

FixItNow: A Hyperlocal AI-Powered Marketplace for Blue-Collar Worker Dispatch Using YOLOv8 Object Detection

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Abstract

Homeowners in India's tier-1 and tier-2 cities struggle to describe household problems well enough for a platform to send the right worker, so manual, text-based categorisation causes misrouted jobs and repeat visits.

We present FixItNow, a hyperlocal marketplace that automates this step through visual problem detection. A homeowner uploads a photo or short video; YOLOv8 models fine-tuned by transfer learning on Roboflow Universe datasets classify the damage as Masonry, Plumbing or Mobile Screen Damage, and the nearest available worker of that trade is matched. The detection pipeline runs as a separate FastAPI micro-service, trained on a consumer laptop GPU (NVIDIA RTX 3050) and connected to a Next.js/Node.js application backed by Supabase. Masonry achieved 83.4% mAP@0.5, Plumbing 51.2% and Mobile Screen Damage 40.1%, reflecting differences in training data and defect subtlety. Tests on real photos and videos, including a phone over a local network, confirmed the pipeline works end to end.

Keywords: YOLOv8; Object Detection; Hyperlocal Marketplace; Transfer Learning; Blue-Collar Worker Dispatch.

ICEMSET-2026/ST/1203

Isolation, identification & optimization of new microbial strain from soil sample for the production of cellulase

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Abstract

Cellulose which is present in abundance in our environment can be utilized as a renewable energy source. Hence, cellulase being the only enzyme that can help us breakdown this lignocellulosic biomass has gained a large interest of scientists and industrialists. Cellulase hydrolyses the β-1,4 bonds of cellulose and breaks it down into smaller glucose molecules. Cellulase enzyme is now used in most of the food businesses, silk industries for the softening of the fabrics and Biofuel production. Isolating the microbes from soil sample and allowing them to grow in CMC agar plate infused with Congo-red for 24hrs at 7.0 pH and temp. maintained at 37°C. The strains were selected with clear zone visible around them, and further grown in optimised condition for the maximum production of cellulase. A total of 4 isolates were taken on the basis of the diameter of clear zone. Later the cellulase produced will be used for biofuel production.

Keywords: Cellulase, Lignocellulosic, Congo red, Biofuel.

ICEMSET-2026/ST/1204

Rapid Detection of Edible Oil Adulteration via using mmWave Sensors and ML

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Abstract

Adulteration of edible oil is one of the important food quality issues particularly for edible oil. In this study, a non-contact and non-destructive method of detecting the adulteration by utilizing the mmWave radar-based sensor is used. Four different edible oil samples were used, for preparing adulterated mixtures, that includes one pure and three different adulterants. To ensure the measurement consistency the samples were placed at a fixed distance of 10 cm from the mmWave radar sensor inside the designed insulated chamber. Two different temperature range 20–25^{0}c and above 25^{0}c were used for measurements. The extracted features from the sensor were used to train a machine learning classifier. The proposed system yields 89% overall classification accuracy, that shows sensor and machine learning is the fast, inexpensive and non-destructive method to detect the adulteration of oil.

ICEMSET-2026/ST/1205

Naphthalene Diimide-Based Organic Semiconductors as Interfacial Materials in Perovskite Solar Cells

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Abstract

The development of organic-material-based devices remains an active area of research in materials science, driven by demand for efficient, sustainable, and structurally tunable alternatives to conventional systems. An efficient device performance requires selecting molecular structures guided by structure-property relationships and employing effective fabrication techniques. Here, we report naphthalene diimide (NDI)-based compounds that yield efficient perovskite solar cells with an organic charge-transport layer. The introduction of various functionalisations at the NDI core and imide positions tunes molecular packing, solubility, frontier orbital levels, and electronic interactions. These changes can align energy levels and reduce charge recombination at the perovskite electron-transport layer interface. By systematically analysing the relationship between molecular structure, optoelectronic properties, and device performance, this research aims to explain how NDI functionalisation influences charge-transport mechanisms and interfacial interactions in perovskite solar cells.

Keywords: Naphthalene diimide; Organic Semiconductors; Perovskite Solar Cells; Interfacial Layers; Optoelectronic Properties.

ICEMSET-2026/ST/1206

A New Approach to Paraganglioma Treatment: The "Inject & Done" Framework

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Abstract

Paraganglioma is a highly vascular tumor that often develops near major blood vessels and cranial nerves, making surgery technically challenging, with risk of vascular and neurological complications. Although nanorobotic technologies offer promising possibilities for targeted therapy, most existing nanobots perform a single specialized function. While these systems are effective individually, complex treatments often require multiple functions to work together, an approach that remains largely unexplored. Rather than developing one multifunctional nanobot, this Perspective proposes a combined nanorobotic framework in which multiple specialized nanobots collaborate within a unified treatment workflow. It explores the capabilities and limitations of Chemical, Magnetic, DNA, and Optical nanobots, examining their potential roles in addressing paraganglioma treatment challenges. The paper presents a conceptual strategy integrating these technologies into a coordinated treatment approach. Finally, broader applications and future research directions are discussed to encourage further research on combined nanorobotic systems for paraganglioma and other complex solid tumors.

Keywords: Paraganglioma; Nanorobotics; Targeted Drug Delivery; DNA Nanobots; Precision Medicine.

ICEMSET-2026/ST/1207

Weed Detection in Fenugreek crops Using DenseNet121 and a Low-Cost Spot Spraying Robot

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Abstract

Weeds compete with crops for water, nutrients and light, and fenugreek suffers most when weeds appear early in the season. Hand weeding is slow and costly, and spraying herbicide over the whole field wastes chemical

and burdens the soil. We built a low-cost robot that sprays only where weeds are found. A wheeled chassis carries a Raspberry Pi 3B+ and Raspberry Pi Camera Module Rev 1.32 that capture field images. A DenseNet121 model, fine-tuned from ImageNet weights on fenugreek crop and weed images and converted to TensorFlow Lite, labels each frame on the Pi itself. When a weed is detected with enough confidence, the Pi switches a relay that runs a small pump for a short burst. The system needs no internet connection and uses inexpensive parts, which suits small farms. We report classification accuracy and processing time on the Pi.

Keywords: Weed detection; Fenugreek; DenseNet121; Raspberry Pi 3B+; Precision spraying.

ICEMSET-2026/ST/1208

Comparative Study of Partially and Fully Etched MXene in Asymmetric Energy Storage Devices

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Abstract

Here, we report a critical analysis of the impact of partial and full MXene etching on structural and electrochemical properties. We used advanced characterization techniques to elucidate the structural and morphological differences between fully and partially etched MXene. The results emphasize the role of structural/morphological analysis of MXene after each batch's synthesis. We used both samples to fabricate electrodes and systematically evaluated their electrochemical performance through 3-electrode Cyclic voltammetry and Electrochemical Impedance spectroscopy in H_3PO_4 electrolyte. Furthermore, we fabricated asymmetric supercapacitors using fully/partially etched MXene and evaluated their gravimetric specific capacitances. Thus, the findings guide new researchers on the importance of Al etching in MXene and on utilizing its full potential in supercapacitor applications.

Keywords: MAX, MXene, 2D materials, etching, electrochemical behavior.

ICEMSET-2026/ST/1209

Can Doping of Alkali Metals Tune Thermoelectric Transport properties of 2D nanosheet: g-C_4N_3 & g-Si_4N_3?

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Abstract

This manuscript represents a comparative ab initio investigation of the temperature-dependent electrical conductance, Seebeck coefficient, Peltier coefficient and thermal conductance of alkali-metal-incorporated carbon and silicon-based nitride systems, namely g-C4N3@X4 and Si4N3@X4 (X = Li, Na, or K), over 150–410 K to estimate their potential as thermoelectric material. The performance is characterized by the interplay of these transport properties and the dimensionless thermoelectric figure of merit, (ZT = GS2Tk). The results reveal positive Seebeck coefficients for carbon-based systems and negative values for silicon-based complements. Carbon-based systems exhibit electrical conductance approximately 108 times higher than silicon-based systems. Potassium incorporation maximizes conductance compared to other alkali materials when attached to carbon-based system nearly at 250 K. Nevertheless, considering the combined transport characteristics, g-C4N3@Na4 and g-C4N3@Li4 appear as more promising thermoelectric candidates than g-

C4N3@K4. We also report silicon-based systems exhibit limited thermoelectric potential because of their extremely low electrical conductance despite larger magnitude of Seebeck coefficient.

Keywords: Thermoelectric transport; graphitic carbon nitride; silicon nitride; alkali-metal incorporation; electrical conductance; Seebeck coefficient; Peltier coefficient; thermal conductivity; figure of merit.

ICEMSET-2026/ST/1210

Green Solution for the Extraction of Microplastics Particles from Water Using Naturally Available Plant Seeds in Jazan Region of Saudi Arabia

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Abstract

The extraction of microplastics from water is crucial due to the considerable dangers they present to aquatic ecosystems and human health. These minuscule plastic fragments may be consumed by aquatic creatures, infiltrating the food web and perhaps accumulating in larger species and humans. Microplastics can also sequester and convey detrimental contaminants, exacerbating the contamination of aquatic resources. Eliminating microplastics from water is essential for maintaining ecosystem equilibrium, guaranteeing potable water, and mitigating prolonged environmental and health hazards. This study investigates the extraction of microplastics from water using seed powders of date, moringa, and tamarind collected from the Jazan region of Saudi Arabia. The coagulation technique was employed, wherein 0.1 gram of each seed powder was mixed with 100 ml of water containing 0.1 gram of microplastics. Following the coagulation process, half of the liquid was separated and weighed to determine extraction efficiency. The experimentation is carried out for various time periods. Results demonstrate that the selected plant seed powders are highly efficient in removing microplastics from water, highlighting their potential as sustainable and natural coagulants for water purification.

Keywords: Extraction of Microplastics, Coagulation Technique, Flocculation Technique, Natural Plant Seed Powders, Jazan Region, Saudi Arabia.

ICEMSET-2026/ST/1211

First-principles insights into lead-free halide perovskites Cs_2SnGeX_6 for green energy applications

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Abstract

Lead-free inorganic double perovskites have attracted considerable interest for clean energy conversion devices due to their environmental benefits. In this work, we present a comprehensive first-principles study of the structural, mechanical, optoelectronic, thermoelectric, and transport properties of the cubic halide perovskites Cs_2SnGeX_6 (X=Cl, Br, I). Our calculations confirm that these compounds are both thermodynamically and mechanically stable. The electronic structure analysis reveals favorable direct band gaps with small carrier effective masses, enhancing optical absorption and transport efficiency. Furthermore, the band edge alignments satisfy the requirements for photocatalytic hydrogen production and carbon dioxide CO_2 reduction. These results demonstrate that Cs_2SnGeX_6 compounds are highly multifunctional candidates for advanced photovoltaic, thermoelectric, and sustainable photocatalytic applications.

Keywords: Photocatalytic; Hydrogen production; Photovoltaic; Halide perovskite; DFT.

ICEMSET-2026/ST/1212

Endometriosis Early Detection System

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Abstract

Endometriosis is a medical disorder affecting approximately 190 million women and girls worldwide. It occurs when tissue similar to the lining of the uterus grows outside the uterus. This condition can cause pelvic pain, menstrual irregularities, and chronic fatigue, negatively affecting physical health, mental well-being, and overall quality of life. Diagnosing endometriosis is challenging because its symptoms often resemble those of other menstrual conditions. Diagnosis may involve clinical examinations, imaging tests, and sometimes surgery, making the process time-consuming and expensive. The system proposed in this paper analyzes menstrual cycle-related parameters, including pain intensity, cycle duration, period duration, and fatigue levels. These parameters are processed using a Long Short-Term Memory (LSTM) model to identify patterns associated with an increased risk of endometriosis. Based on the analysis, the system generates a risk score to support awareness, encourage early screening, and help individuals seek appropriate medical evaluation when necessary.

Keywords: Endometriosis, Long Short-Term Memory (LSTM), Menstrual Cycle Data, Early Risk Prediction, Machine Learning.

ICEMSET-2026/ST/1213

Smart Water Quality Monitoring and Contamination Detection with Predictive Analysis and Corrective Recommendation

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Abstract

Maintaining water quality in household and community tanks requires continuous monitoring and timely corrective action. This paper presents a smart water quality monitoring system integrating IoT sensors, trained machine learning models, predictive analysis and corrective recommendations. An ESP32 measures pH, turbidity, total dissolved solids (TDS) and temperature transmitting readings through Wi-Fi to a Flask application and SQLite database. Trained Random Forest and Isolation Forest models, combined with Z-score analysis, identify abnormal water quality patterns through a hybrid detection approach. The hybrid detector achieved 98.8% accuracy, 79.31% precision and 100% recall on the evaluated test dataset. Rule-based threshold assessment further identifies potentially unsafe conditions. Based on detected conditions, the system generates alerts and suggests appropriate corrective actions. Additionally, an LSTM network forecasts future water quality parameter values using historical readings. By combining real-time monitoring, trained-model detection, forecasting and decision support the system facilitates timely assessment and management of water quality in household and community tanks.

Keywords: Internet of Things (IoT); Smart Water Quality Monitoring; Hybrid Anomaly Detection; Random Forest; Isolation Forest; LSTM Forecasting.

ICEMSET-2026/ST/1214

Design and Implementation of a Hall-Sensor BLDC Motor Controller for a 48 V Electric Prototype

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Abstract

This work documents the motor controller is built for 48 V electric prototype. It runs a Hall-sensor BLDC motor using trapezoidal commutation. A Raspberry Pi Pico reads the throttle (0-5V) and the three Hall signals, then generates the PWM that drives the power stage. That stage is six N-channel MOSFETs arranged as three half-bridges and switched through DGD2304 gate drivers. A TC1240 charge pump supplies the 10 V gate drive, and a K78U05 regulator supplies the 5 V logic. Motor current is measured across a 0.5 mΩ shunt with an INA181A1 amplifier, and battery voltage through a resistor divider, so the firmware can cut the PWM on overcurrent or undervoltage. The board is rated for 20 A, with a 30 A limit for five seconds, and has an on-board fuse. We also cover the schematic, PCB layout, control flow and the assembled board.

Keywords: BLDC motor controller; Trapezoidal commutation; Hall-effect sensing; Gate driver; Electric prototype.

ICEMSET-2026/ST/1215

Design and Manufacturing of an FSAE Vehicle's BMS Slave PCB

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Abstract

An effective battery management system (BMS) is essential for the safe and reliable operation of an electric vehicle's battery pack. This project focuses on the design and manufacturing of a BMS slave printed circuit board (PCB) intended to interface with individual battery cells and support battery-pack monitoring. The work involves translating the system requirements into a circuit design, developing the PCB layout, and preparing the board for fabrication and assembly. The design considers practical constraints such as component placement, signal integrity, electrical connections, and integration with the wider BMS architecture. The slave PCB is intended to acquire battery-related measurements and communicate the relevant information to the master BMS, enabling pack-level supervision and protection. The project brings together electronic circuit design and PCB manufacturing considerations for an electric-vehicle application. The result is a purpose-built PCB design that can serve as a building block for a modular battery management system, with functional validation required to confirm its performance in the intended battery-pack environment.

Keywords: Battery Management System; BMS Slave PCB; Electric Vehicle; PCB Design; Battery Monitoring.

ICEMSET-2026/ST/1216

Evaluation of Plant-Derived Bioactive Extracts Against Cancer Cell Lines Using 2D and 3D Culture Models

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Abstract

Cancer remains one of the leading health concerns worldwide. Cancers affecting the nervous system represent a particularly complex group of malignancies due to their aggressive behaviour, therapeutic resistance and heterogenous tumor microenvironment. Therefore, improved therapeutic strategies and reliable screening models for identifying potential anticancer components are required. Two-dimensional (2D) cell culture models are widely used for initial anticancer screening because of their simplicity and ease of handling; however, they have limited ability to reproduce 3D architecture, cell-cell interactions, and physiological characteristics of tumors. Three-dimensional (3D) tumor spheroid models provide a more physiologically relevant alternative better mimic several features of the in vivo tumor microenvironment. In the present study, 20 hydro-alcoholic plant extracts were prepared and screened for their cytotoxic effects against neurocancer cell lines (SH-SY5Y

and U87), using both 2D and 3D culture models. Spheroid formation was standardised, and the cytotoxic effects of the plant extracts were analysed on these spheroids via MTT assay. Among the extracts, Kaner, Bathua and Babul showed comparatively higher cytotoxicity in 3D models. These findings highlight the potential of 3D tumor spheroids as a physiologically relevant screening platform for identifying underexplored plant bioactive compounds as promising sources of novel anticancer agents.

ICEMSET-2026/ST/1217

Enhanced Piezoelectric Performance in Copper-Modified $(BaCeCa)(ZrCu_yTi)O_3$ Lead-Free Ceramic

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Abstract

This study emphasized the synthesis, structural and electrical properties of $(BaCeCa)(ZrCu_yTi)O_3$, where $0 < y < 0.026$, lead-free ceramics synthesized by the solid-state reaction method. X-ray diffraction analysis revealed that all specimens displayed a typical perovskite structure at room temperature. Dense microstructure along with perfect grains and clear grain boundaries, was obtained in all ceramics. In addition, with increase of Cu doping, the Curie temperature was observed to decrease from 136 ºC to 116 ºC. The ceramic with $y = 0.014$ exhibited excellent electrical properties: dielectric constant (ε_{max}) ~ 9368, ε (at room temperature) ~ 2689, dielectric loss ($\tan\delta$) ~ 2 %, Curie temperature (T_C) = 127 °C. Besides, a good temperature coefficient of dielectric permittivity $\Delta\varepsilon_r/\varepsilon_{RT} \sim \pm 12$ % was observed in the temperature range of 20-100 °C for this composition. The conduction mechanism was investigated using impedance spectroscopy at various temperatures (200–450 °C), and the values of resistance and conductivity associated with the grain and grain boundaries were assessed. A high value of the piezoelectric coefficient (d_{33}) = 420 pC/N was observed for composition $y = 0.020$. These results indicate that BCZT ceramics co-doped with Ce and Cu could be promising candidates for use in piezoelectric and energy harvesting devices.

Keywords: Barium titanate, perovskite structure, phase transition, thermal stability, piezoelectric.

ICEMSET-2026/ST/1218

Frequency- and Temperature-Dependent Dielectric Properties and Electrical Conduction Mechanism of PANI/ZnO Nanocomposites with 20 wt.% ZnO

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Abstract

Polyaniline and zinc oxide nanocomposites (PANI/ZnO NCs) containing 20 wt% of ZnO was prepared using an in-situ chemical oxidative polymerization method. investigated to understand their dielectric and electrical properties. The dielectric response was evaluated by impedance analyzer analysing the real part of the dielectric constant (ε′), imaginary part of the dielectric constant (ε″), dielectric loss tangent (tan δ), electric modulus ($M^{''}$), and AC conductivity over frequency range(1Hz-10MHz) at different temperature (153K-373K). The dielectric properties of the composite are influenced by the interaction between the ZnO nanoparticles and the PANI polymer chains. The frequency-dependent dielectric response can be explained by interfacial polarization and the Maxwell–Wagner–Sillars effect. The dielectric constant for the PANI/ZnO composite (i.e. ~1070) is high as compared to pristine PANI (i.e. ~16). The value of dc electrical conductivity has been increased from $5.7x10^{-9}$ S/cm to $5.61x10^{-8}$ S/cm indicates the enhancement in dielectric properties. At lower frequencies, charge accumulation at the interfaces contributes to dielectric polarization, whereas at higher frequencies, the dielectric constant generally decreases because the charge carriers cannot follow the rapidly alternating electric field. The AC conductivity provides further insight into the charge transport mechanism within the composite. The

incorporation of ZnO nanoparticles modifies the electrical response of the PANI matrix and may influence its dielectric relaxation behaviour. This study provides an understanding of the dielectric characteristics of PANI/ZnO nanocomposites and their potential for applications in electronic and dielectric devices.

Keywords: Polyaniline, zinc oxide, dielectric properties.

ICEMSET-2026/ST/1219

Dielectric Properties of Polythiophene/Copper Oxide (PTh/CuO) Nanocomposite with 15 wt.% CuO Doping

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Abstract

Polythiophene (PTh) is a conducting polymer that has attracted considerable attention due to its electrical properties, environmental stability, and potential applications in electronic devices. In the present study, a polythiophene/copper oxide (PTh/CuO) nanocomposite containing 15 wt% CuO synthesized by in-situ polymerization method is investigated to understand the effect of CuO incorporation on its dielectric and electrical properties in frequency range(1Hz-10MHz) with different temperature(153K-373K). The dielectric behaviour of the prepared material can be studied by analyzing the dielectric constant, dielectric loss, electric modulus, and AC conductivity over a range of frequencies and temperatures. The incorporation of CuO nanoparticles into the PTh matrix is expected to modify the dielectric response through interfacial polarization and charge-carrier transport. The frequency-dependent dielectric behaviour can provide information about polarization mechanisms and dielectric relaxation. The dielectric constant for the PTh/CuO composite (i.e. ~$4x10^3$) is high as compared to pristine PTh (i.e. ~10^2). The value of dc electrical conductivity has been increased from $65x10^{-9}$S/cm to $4.31x10^{-8}$S/cm indicates the enhancement in dielectric properties. while the AC conductivity analysis can help explain the charge-transport process. Temperature-dependent measurements can further clarify the role of thermal activation in electrical conduction. The study of the PTh/CuO nanocomposite may provide useful insights into the relationship between composition, dielectric relaxation, and electrical transport, highlighting its potential for dielectric, capacitive, and electronic applications.

Keywords: Polythiophene, copper oxide, dielectric properties.

ICEMSET-2026/ST/1220

ForensiSync: AI-Powered Forensic Investigation Platform with Neural 3D Scene Reconstruction, Evidence Intelligence, and Blockchain Certification

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Abstract

Traditional forensic investigations face challenges in accurate crime scene documentation, evidence analysis, three-dimensional reconstruction, and secure report management. The Bharatiya Nagarik Suraksha Sanhita (BNSS) 2023 emphasizes forensic investigation and documentation for specified serious offenses, highlighting the need for accessible digital forensic solutions. We present ForensiSync, an AI-powered, web-based platform designed to streamline the crime scene investigation lifecycle. The system integrates Neural 3D Gaussian Splatting for reconstructing photorealistic three-dimensional crime scenes from smartphone photographs, YOLOv8 for automated evidence detection and classification, and Segment Anything Model 2 (SAM 2) for precise evidence segmentation. Browser-based spatial measurement supports scene analysis, while speech-to-text functionality enables investigators to record observations efficiently. Furthermore, blockchain-based certification and cryptographic verification strengthen report integrity and traceability. By combining evidence intelligence, immersive scene visualization, automated documentation, and secure digital reporting within a unified architecture, ForensiSync aims to provide a cost-effective forensic investigation solution.

Keywords: Digital Forensics; 3D Gaussian Splatting; Crime Scene Reconstruction; YOLOv8; SAM 2; Blockchain Certification; BNSS 2023; Evidence Intelligence.

ICEMSET-2026/ST/1221

Design and Simulation of a DC-DC Converter on MATLAB

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Abstract

This project presents the design and validation of an isolated flyback DC-DC converter for a Formula Student Electric Vehicle, converting high-voltage accumulator output into a regulated 12V supply for low-voltage auxiliary systems, eliminating the need for a separate auxiliary battery. Load analysis established a demand of 8.528A (102.3W), leading to specifications of 120W continuous and 180W peak. The flyback topology was selected for its simplicity, galvanic isolation, and suitability for low-power applications. Key parameters include a 16:1 transformer turns ratio, 150 µH primary inductance, ETD34 ferrite core, 900V SiC MOSFET, and 100V Schottky rectifier. A PI-based closed-loop PWM controller using the UCC28C43 IC maintains output voltage within ±1%. MATLAB simulations validate steady-state performance, load-step response, and approximately 92% efficiency. The converter eliminates a 2.8 kg auxiliary battery, reducing vehicle mass while improving energy efficiency and demonstrating practical power electronics integration for Formula Student applications.

Keywords: Flyback Converter, Formula Student, DC-DC Converter, Galvanic Isolation, SiC MOSFET, MATLAB Simulation, FSAE, EV Auxiliary Power.

ICEMSET-2026/ST/1222

Design and Analysis of Forced Air Convection Cooling Solution for a Lithium-Ion Battery Pack

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Abstract

An effective battery thermal management system is essential for the safe and reliable operation of an electric vehicle's battery pack. This project focuses on the design and analysis of a forced air convection cooling system for a Formula Student electric vehicle battery pack. The study involves estimating heat generation within lithium-ion cells using Joule's heating principle and determining the required airflow through energy balance calculations. A distribution duct was designed and optimized to improve airflow uniformity across the battery cells while minimizing pressure losses and satisfying packaging constraints. Computational Fluid Dynamics (CFD) simulations using SimScale were performed to evaluate airflow distribution, pressure drop, and thermal performance. The cooling system was designed to deliver an airflow rate of 135 CFM to meet the estimated thermal requirements. Endurance simulations covering two 22 km stints at different motor torque settings indicated stable battery temperatures between 29°C and 31°C. The results demonstrate the potential of forced air convection as a lightweight, economical, and practical cooling solution for electric vehicle battery packs operating under moderate thermal loads.

Keywords: Lithium-Ion Battery; Battery Thermal Management System; Forced Air Convection; Computational Fluid Dynamics; Duct Design.

ICEMSET-2026/ST/1223

Bioplastic composite films of pyrazoline derivatives doped chitosan with UV-deterring properties for ecofriendly packaging

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Abstract

Chitosan bioplastic packaging has been emerging as a high-potential sustainable alternative in the Indian packaging market. The UV protection properties of composite materials designed for sustainable packaging are very important in protecting the quality of packaged foods from photochemical damage caused by UV rays. So, in the present work we report the synthesis of new 2-[5-(3,4-dimethoxyphenyl)-1-phenyl-4,5-dihydro-1H-pyrazol-3-yl]phenol (Pyz-1) and 4-[5-(3,4-dimethoxyphenyl)-1-phenyl-4,5-dihydro-1H-pyrazol-3-yl]phenol (Pyz-2) and their chitosan composites ChPyz-1 and ChPyz-2 respectively. The respective composites Chpyz-1 and ChPyz-2 exhibited SPF of 44.11and 47.77 and UPF 22.1 and 102. Absorption coefficient, refractive index and optical conductivity of ChPyz-1 found to be greater than the ChPyz-2 with the values 1.98<2.41, 1.87<2.12 and 6.38E9<7.15E9 respectively. Further, the mechanical properties like tensile strength of the composite films found to be tremendously enhanced than the pristine chitosan. Hence, these robust and durable newly fabricated composite films with the excellent SPF and UPF values, found to be promising biodegradable plastics of UV deterrent properties.

Keywords: Pyrazoline; Chitosan composite; SPF; UPF; bioplastic.

ICEMSET-2026/ST/1224

Fog Computing in VANETs: A Review of Mobility-Aware Routing and Traffic Management

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Abstract

Vehicular Ad Hoc Networks (VANETs) are emerging technologies that enable vehicles to communicate with each other and with roadside infrastructures to improve road safety, optimize traffic management and enable effective information exchange between vehicles. In practice, however, issues such as dynamic changes in the position of vehicles, frequent network disconnection, and delay in communication pose significant challenges when attempting to achieve reliable vehicular data transmissions. Fog computing has been proposed as an innovative solution to mitigate some of the challenges faced by VANETs through the provision of computing and storage resources close proximity to the vehicles. This paper reviews the existing literature concerning the deployment of fog computing in VANETs, including mobility-aware routing, data dissemination, traffic management, and resource allocations. We examine factors such as vehicle mobility, traffic condition, mobility model, and various routing protocol affecting the performance of vehicular communications within fog assisted-VANETS. Furthermore, we discuss challenges regarding fog node selection, frequent handovers, resource availability, security and privacy. Potential integrations of adaptive mobility models and routing optimization technique are explored to further ensure reliable vehicular communications. Research gaps and future directions regarding the development of scalable, efficient, and mobility aware fog assisted-VANETS are identified.

Keywords: VANETs, Fog Computing, Mobility Models, Routing Protocols, Traffic Management, Data Dissemination, Intelligent Transportation Systems.

ICEMSET-2026/ST/1225

Design and Analysis of a Lightweight Composite Battery Pack Enclosure for Electric Vehicles

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Abstract

This work presents the design and analysis of a lightweight composite battery pack enclosure for electric vehicles, aimed at reducing mass relative to a conventional aluminium enclosure while meeting structural, fire-retardancy and electrical-insulation requirements. A sandwich construction was adopted, comprising aramid woven face sheets, a UL94 V-0 rated epoxy matrix and a Nomex honeycomb core. The enclosure was modelled parametrically in SolidWorks, and the laminate layup was optimised using ANSYS Workbench with ACP under 40G longitudinal and lateral loading, using inverse reserve factor and a 0.4% strain limit as criteria. The final design used 6C6 laminates for the lid and walls and a 7C7 laminate for the base, giving a maximum IRF of 0.53. Fire retardancy and electrical insulation are satisfied inherently by the materials. The enclosure mass is 6 kg versus 17 kg for the aluminium equivalent, a 64% saving, reducing pack mass from 67 kg to 56 kg.

Keywords: Composite battery enclosure; Sandwich panel; Aramid–Nomex; ANSYS ACP; Lightweight design.

ICEMSET-2026/ST/1226

A Review of LLM-Based Approaches for Website Usability and Design Evaluation

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Abstract

The explosion of web applications has created a greater need for a systematic approach to website evaluation in terms of usability, look and feel, accessibility, functionality, and user satisfaction The recent emergence of large language models (LLMs) has opened new possibilities for automating and enhancing website evaluation via natural language understanding, code analysis, visual analysis, and interactive browser-based testing. This paper is a review of the use of LLMs in website usability and design evaluation. It looks at their application in the assessment of interface consistency, navigation, information architecture, visual hierarchy, readability, accessibility, responsiveness, and interactive functionality. A significant focus is on the combination of qualitative design analysis with quantitative usability metrics to produce a more complete and useful evaluation. The paper discusses the problems with LLM-based approaches in terms of the reliability of evaluation, model bias, inconsistent judgements, lack of understanding of actual user behaviour, and difficulty in assessing subjective design judgements. The aim of the paper is to provide a coherent and structured overview of the role that LLMs can play in the creation of more usable, accessible, visually effective and user centric websites.

Keywords: Large Language Models (LLMs), Website Evaluation, Web Usability, User Interface Design, User Experience (UX), Automated Testing, Accessibility, Human–AI Evaluation.

ICEMSET-2026/ST/1227

MCDM-Based Design and Criterion Selection for a Sustainable Hostel Food Waste-to-Energy System

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Abstract

Hostel messes produce a large amount of food waste every day, most of which ends up in disposal systems, contributing to environmental and economic problems. Converting this waste into energy through waste-to-energy (WtE) technologies offers a way to reduce the burden of final disposal while recovering useful resources. This project shall present a structured approach to selecting and designing a suitable WtE system for hostel food

waste. A systematic literature review has been carried out to identify available WtE options, including anaerobic digestion, gasification, incineration, and biogas recovery from landfills. Additionally, preliminary data collected from our hostel indicate that approximately 60–70 kg of food waste is generated daily by a hostel housing around 650 students. Next, the MIC-MAC method (Matrice d'Impacts Croisés Multiplication Appliqués à un Classement) shall be used to identify and select the criteria and sub-criteria, grouped under technical, environmental, and social aspects. These criteria shall then be weighted and ranked using the Analytic Hierarchy Process (AHP) and the Technique for Order of Preference by Similarity to the Ideal Solution (TOPSIS). Finally, a sensitivity analysis shall be performed to evaluate the stability of the ranking under variations in criteria weights. The project aims to provide hostel administrators with a clear, evidence-based approach to selecting a sustainable food waste-to-energy system.

ICEMSET-2026/ST/1228

Symbol2Text: An AI-Driven Pipeline for Recognizing and Translating Ancient Scripts

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Abstract
Egyptian hieroglyphs are ancient symbols important to archaeologists, historians, and linguists. Recognizing them is challenging because their appearance varies with size, rotation, carving style, image quality, and surface damage. Manual recognition also requires expert knowledge. To address these challenges, we developed Symbol2Text, an AI-based hieroglyph detection system using the lightweight YOLO26n model integrated into a Streamlit web application. Users can upload images, and the system identifies symbols by displaying bounding boxes, class names, and confidence scores. The model achieved 68.7% precision, 79.8% recall, 85.8% mAP@50, and 55.7% mAP@50–95. Additionally, classification accuracy on matched objects reached 96.10% using the saved best.pt weights. These results demonstrate the potential of lightweight object detection for hieroglyph recognition. However, the application identifies individual symbols rather than translating complete texts. Future improvements include recognizing different writing styles, determining reading order, transliteration, and expert validation to improve accuracy and usability.

Keywords: Egyptian Hieroglyphs, Symbol Detection, Object Detection, Deep Learning, Computer Vision, Image Processing, YOLO26n, Symbol Recognition, Ancient Egyptian Text, Streamlit, Automated Recognition.

ICEMSET-2026/ST/1229

Augmented Video Dataset of Inter-Frame Video Forgeries

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Abstract
Nowadays, video forgeries compromise reliability, authenticity and integrity of digital video. In the video forensics domain, some techniques identity inter-frame video tampering however scarcity of benchmark datasets is bottleneck for validating tampering detection techniques. This paper proposes the development of augmented video dataset comprising forged videos generated through inter-frame tampering such as insertion, deletion and duplication of frames. Large augmented dataset is useful for deep learning and compression-based video tampering detection techniques. The dataset is augmented by multiple variations such as color blending, intensity variation, rotation, horizontal and vertical flipping, Gaussian noise injection, brightness and contrast modification, spatial cropping to get augmented dataset of large size comprising 9291 videos. The state-of-the-art method yields accuracy of 86.5% over proposed dataset to detect frame insertion, deletion and duplication type of inter-frame video forgeries. The comparative study states that dataset size is key factor that affects performance of video forgery detection techniques.
Keywords: Video forensics, Inter-frame video forgeries, Video tampering dataset, Augmentation.

ICEMSET-2026/ST/1230

Design of Smart IoT Framework for Elderly Safety Monitoring system

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Abstract

The worldwide population of elderly members is growing quickly and more and more people are needing to engage with smart, inexpensive and secure healthcare monitoring systems to help them live independently; however, the vast majority of the solutions on the market simply react after a fall or if the elderly has suffered a health incident, leading to delayed treatment and preventable injuries. To overcome the above problem, a dual stage IoT-based safety monitoring and early fall-risk prediction scheme for elderly is proposed. Stage I involves an ESP32 microcontroller that has been fitted with an MPU6050 accelerometer-gyroscope, a MAX30102 pulse-oximeter sensor, a temperature sensor, and an MQ2 gas sensor to continuously gather data on motion, vital-sign and environment, sending it to the cloud for storage, which can be accessed through Wi-Fi. In stage II, this data is used by a mobile/ web application to send alerts to the caregiver and family members by buzzer, push notification and SMS, whenever abnormal movement pattern is detected by predictive analytics and there is potential fall risk. The integration of the sensor and the accurate real-time visualization of the measured values, namely heart rate, SpO2, body temperature, and gas level, on the dashboard, as well as the reliable operation of the risk-prediction module were verified with a working prototype. The findings validate that the suggested system is scalable, affordable, and dependable for improved safety of the elderly and faster emergency response.

Keywords: Internet of Things (IoT), Elderly Care, Fall Detection, ESP32, Predictive Analytics, Health Monitoring, Cloud Computing, Wearable Sensors.

ICEMSET-2026/ST/1231

Size and Concentration Dependent Optical Modulation in ZnO–PNIPAM-Coated Polymer Fibres for Adaptive Textile Lighting

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Abstract

Stimulus-responsive optical fibres offer promising opportunities for adaptive lighting, smart textiles and temperature-sensitive optical devices. This study proposes to investigate the influence of zinc oxide (ZnO) nanoparticle size and concentration on temperature-dependent light distribution in flexible polymer optical fibres coated with poly(N-isopropylacrylamide) (PNIPAM). ZnO nanoparticles with nominal sizes of 10, 20 and 30 nm will be incorporated at dispersion concentrations of 0.5, 1.0 and 2.0 mg/mL. Side-emitted and end-transmitted light intensities will be evaluated at 25 and 40 °C under controlled illumination, with reversibility assessed over repeated heating–cooling cycles. Uncoated fibres and fibres coated with PNIPAM alone or ZnO alone will serve as controls. The study aims to clarify how nanoparticle characteristics and thermoresponsive polymer behaviour influence optical modulation and recovery. The findings may support the development of flexible, temperature-responsive optical fibres for adaptive textile lighting.

Keywords: Zinc oxide nanoparticles; PNIPAM; polymer optical fibres; optical modulation; thermoresponsive materials; smart textiles.

ICEMSET-2026/ST/1232

Impact of Reinforcement Material on Wear Behaviour of Aluminium Metal Matrix Composite

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Abstract

Aircraft and automobile manufacturers use aluminium alloy 7075 extensively due to its excellent strength-to-weight ratio but it is inadequate for wear conditions due to its low wear resistance. The present investigation focuses on developing a cost-effective, low-density Al7075 matrix composite reinforced with SiC (0, 5 and 10 wt.%) via stir casting route to serve as an alternative to heavier traditional alloys for aerospace and automotive applications and helps in understanding how varying SiC content influences the overall performance of the composite. The microstructure of Al7075 MMC was examined using optical microscope, whereas the scanning electron microscopy (SEM) and X-ray diffraction analyses show the presence of uniformly distributed SiC particles causing refinement of grains and strengthening of interface. Dry sliding wear properties of the material were studied by pin-on-disc wear testing machine under a constant sliding speed of V = 1.48 m/s under a varying load of 20-60 N applied to the pin at room temperature. The results suggest that the addition 10 wt.% of silicon carbide enhances microstructure, wear resistance of the material as compared to other compositions. This research helps us find a relationship between SiC content and its performance.

Keywords: Al7075 alloy, Silicon Carbide, Metal Matrix Composites, Stir Casting, Microstructure, Mechanical Properties, Wear Behaviour.

ICEMSET-2026/ST/1233

Design and Development of a Waste-to-Electricity Generation System Using Thermoelectric Conversion

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Abstract

Waste generation keeps increasing every year, and at the same time electricity demand is also going up, so we need systems that can handle both problems at once. In this paper we designed and built a low-cost system that converts solid waste like plastic, paper and dry leaves into electricity. The waste is burned inside a combustion chamber and the heat produced is converted into electrical energy with the help of a thermoelectric generator (TEG) panel, which works on the Seebeck effect. This DC output is then rectified, regulated and stored in a rechargeable battery, and the battery powers small DC loads such as LED bulbs through a switch circuit. We also added a pollution filter that captures the smoke particles coming out during burning, and the carbon collected from this filter can be reused to make ink, so there is an extra benefit apart from just electricity. We built a working prototype and tested it, and the results show that the waste heat is successfully converted into usable electricity, which we confirmed by the LED loads glowing, along with proper smoke filtering and carbon collection. Overall, this system gives a simple, cheap and eco-friendly way to generate power in a distributed manner while also helping with solid waste management.

Keywords: Waste-to-Energy, Thermoelectric Generator (TEG), Seebeck Effect, Renewable Energy, Solid Waste Management, Carbon Recycling, Sustainable Energy.

ICEMSET-2026/ST/1234

AI-Powered Aerial Automated Threat Detection and Secure Evidence Verification System

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Abstract

Unmanned aerial vehicles (UAVs) are increasingly used for surveillance and industrial safety, but the reliability of captured images can be affected by image tampering and adversarial attacks. This paper presents an integrated framework for aerial fire and smoke detection with secure evidence verification. The proposed pipeline combines input validation, SHA-256 image integrity checking, image-tampering analysis, adversarial screening, image enhancement, and YOLO-based fire and smoke detection. Confidence verification supports the review of uncertain detections, while risk assessment and secure evidence logging provide traceable inspection records. On the evaluated test set, the model achieved 90.38% precision, 85.72% recall, 92.31% mAP@50, and 64.96% mAP@50–95. In an industrial safety inspection, the system identified 26 relevant events, detecting fire in all 26 and smoke in 24. The integrated approach aims to improve the reliability, traceability, and practical usefulness of UAV-based safety monitoring.

Keywords: UAV surveillance; Fire and smoke detection; YOLO; SHA-256; Digital forensics.

ICEMSET-2026/ST/1235

Innovative Spray-Coating Techniques for Hard Carbon Anodes in Sodium-Ion Batteries

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Abstract

Sodium-ion batteries are a suitable alternative to lithium-ion batteries. Hard carbon (HC) electrodes are a suitable active anode material for non-valent ion batteries. This work aims to sdevelop a cost-effective spray-coating process to prepare HC composite electrodes on copper current collectors with varying binder (sodium carboxymethyl cellulose, CMC) content and HC particle size. In this study, HC composite electrodes with different HC particle sizes and binder contents (2.5%, 5%, and 10% CMC) were prepared with controlled thickness and mass loading. The project investigates electrochemical performance and SEI stability, linking them to surface reactivity and cycling stability in HC composite electrodes with 5 μm (type II) HC particles. This work evaluates spray-coated electrodes in 1 M sodium perchlorate (NaClO4) in propylene carbonate (PC), independent of CMC content, with and without fluoroethylene carbonate (FEC) as an additive, and compares their performance to doctor-bladed HC electrodes. Spray-coated anodes in half-cells showed higher capacity in the first cycles than doctor-bladed anodes of similar thickness. Time-of-flight secondary ion mass spectrometry (ToF-SIMS) studies reveal a significant increase in inorganic fluoro-compounds in the formed solid electrolyte interphase (SEI) when FEC was present as an additive. In addition, the first single-electrode microcalorimetry studies on spray-coated thin HC composite electrodes yielded an entropy of sodiation of 80 J mol^{-1} K^{-1} at high state of charge (SoC), comparable to that of bulk Na deposition. Spray coating effectively produces notably thin HC films with rapid electrochemical and thermal responses, making them highly suitable for microcalorimetry experiments.

Keywords: Spray-coating; Hard carbon; Intercalation; SEI layer; Sodium-ion batteries.

ICEMSET-2026/ST/1236

Design and Experimental Evaluation of 3D printed Bio-Inspired Soft Robotic Gripper

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Abstract

Biological structures offer valuable principles for developing robotic systems to adapt to objects of varying shapes and sizes. Inspired by radial organisation and compliant morphology of floral structures, this work presents the design, fabrication, and experimental evaluation of a bio-inspired soft robotic gripper for adaptive grasping. The gripper features radially arranged, 3D-printed petals incorporating a cross mesh architecture for structural compliance while limiting solid material. Fabricated using a 0.4 mm nozzle, the prototype has opening diameter ranging from 30 mm to 200 mm. Gripping experiments were conducted using objects with diverse geometries, including plastic bucket, water bottle, tissue box, sunglasses box, triangular stand, and cylindrical box. The prototype demonstrated potential of accommodating diverse objects through enveloping. This work translates floral architecture into a functional robotic gripping mechanism and the potential of bio-inspired geometry along compliant materials for adaptive manipulation.

Keywords: Bio-inspired Robotics; Soft Robotic Gripper; Compliant Structures; Adaptive Grasping; Additive Manufacturing.

ICEMSET-2026/ST/1237

Experimental Investigation and Multi-Criteria Optimization of Wood-Plastic Composite Filament for FDM-Based 3D Printing

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Abstract

The increasing use of 3D printing has led to a greater need for materials that are both sustainable and cost-effective. Waste wood can be used as a renewable filler in polymer composites, helping to promote recycling and sustainable manufacturing practices. This project focuses on developing and testing a wood–plastic composite (WPC) filament for fused deposition modelling (FDM) 3D printing. The filament uses waste wood powder as the filler and polylactic acid (PLA) as the base material. The waste wood powder will be processed by cleaning, drying, grinding, and sieving, then mixed with PLA in different proportions: 0%, 5%, 10%, and 15% by weight. The resulting blends will be extruded into 1.75 mm diameter filament. Specimens will be printed using a Taguchi L9 design, which will vary the wood content, nozzle temperature, layer height, and infill density. These specimens will be tested for tensile strength, flexural strength, impact strength, hardness, surface roughness, dimensional accuracy, and water absorption. The results will be compared with those of pure PLA specimens. Since no single property can determine the best material, a hybrid multi-criteria decision-making (MCDM) model called AHP–TOPSIS will be used to evaluate and rank the different material combinations based on all the tested criteria. The best combination will then be used to print a functional prototype. This mid-semester report outlines the completed groundwork, including a literature review, research gap analysis, objectives, MCDM framework, experimental design, and testing plan. It also details the current progress and the plan for the rest of the semester.

Keywords: Wood–plastic composite, PLA, FDM, 3D printing, waste wood, Taguchi method, multi-criteria decision making, AHP–TOPSIS, sustainable manufacturing

ICEMSET-2026/ST/1238

Growth and Characterization of Creatininium Cyanoacetate Single Crystals: Structural, Optical, Thermal, and Mechanical Properties

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Abstract

The present study reports the successful growth and investigation of organic creatininium cyanoacetate (CCA) single crystals, were grown using slow evaporation solution growth technique (SEST). A good quality plate like crystals were harvested. The grown compound crystallizes in monoclinic crystal system, with P21 space group, providing insight into its crystallographic characteristics. The chemical shift(δ) corresponding to different hydrogen and carbon hydrogen atoms present within CCA compound was recorded using NMR analysis. The grown material exhibits thermal stability up to approximately 170 °C. The optical properties were investigated, which yielded an optical band gap of approximately 4.7 eV. The mechanical behavior was evaluated using microhardness measurements, providing information about its indentation response and mechanical characteristics. The combined structural, optical, thermal, and mechanical investigations offer a comprehensive understanding of creatininium cyanoacetate as an organic crystalline material. These findings provide a foundation for further investigation of the material's potential in optical and other functional applications. The development of organic crystalline materials with desirable optical, thermal, and mechanical properties is of considerable interest in materials science.

Keywords: slow evaporation solution growth; single-crystal X-ray diffraction; optical band gap; thermal stability; Meyer's index.

ICEMSET-2026/ST/1239

CNN-Based Clinical Mastitis Detection in Dairy Cows Using Integrated Udder Images and Milk Quality Parameter Analysis

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Abstract

Clinical mastitis in dairy cows affects udder health, milk quality, and milk production. Early detection is essential for support timely intervention and reducing economic losses in dairy farming. This study proposes an artificial intelligence-based mastitis screening system using udder images and milk parameters. We use Convolutional Neural Network (CNN) is to classify udder images. At the same time, a Random Forest model analyzes somatic cell count, milk electrical conductivity, and milk pH to identify potential mastitis cases. Grad-CAM is incorporated to highlight image regions influencing the CNN's predictions, improving interpretability. The milk-parameter model was evaluated using held-out test dataset, demonstrating promising results for distinguishing healthy cows from those potentially affected by mastitis. Further validation with independent cow records is needed to confirm real-world reliability. The system provides an accessible screening aid for dairy farmers and support early identification of potential mastitis cases. It intended to complement, professional veterinary assessment.

Keywords: Clinical Mastitis, Convolutional Neural Network, Random Forest, Grad-CAM, Milk Quality Analysis.

ICEMSET-2026/ST/1240

Phytochemical Functionalised Cellulose Acetate Membrane for Sustainable Removal of Lead (Pb(II)) from Contaminated Water

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Abstract

Lead contamination of water is a major global health concern, as it is non-biodegradable, accumulates in the body, and causes neurological, reproductive, and cardiovascular problems, specifically threatening children and pregnant women even in trace amounts. It enters water through industrial effluents and urban runoff. Conventional removal methods such as chemical precipitation or electrochemical treatment are costly, produce toxic sludge, and remove little lead at low concentrations. Membrane filtration offers a selective, energy-efficient, and scalable alternative. Cellulose is a renewable, biodegradable membrane material, but it binds metal ions poorly on its own. This study functionalises cellulose membranes with phytochemicals from *Eleocharis ochrostachys*, an aquatic plant, and incorporates them into the membrane at concentrations of 0.1, 0.5, 1, and 2%. Its phytochemicals add hydroxyl, carboxyl, and amine groups that chelate lead ions, improving adsorption capacity and selectivity, with 2% incorporation depicting the maximum lead removal. The membranes were characterised for porosity, surface area, functional groups, and mechanical strength using spectroscopy, electron microscopy, and surface-area analysis. Batch filtration tests examined lead removal at varying pH, contact time, and lead concentration, with comparison against unmodified cellulose and conventional treatments. The approach converts the plant's natural detoxification mechanism into a portable, sustainable water purification technology.

ICEMSET-2026/ST/1241

Effect of RTV Polysiloxane (PDMS) Coating on Water Resistance and Surface Quality of 3D-Printed ABS

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Abstract

Fused deposition modeling (FDM) of acrylonitrile butadiene styrene (ABS) produces porous, stepped surfaces vulnerable to capillary water ingress and UV degradation. Conventional rigid sealants and sol-gel ceramics fail due to interfacial stiffness mismatch or high calcination temperatures exceeding the glass transition temperature of ABS. This study investigates an elastomeric room-temperature vulcanizing (RTV) polydimethylsiloxane (PDMS) coating applied to FDM ABS specimens printed at 50, 70, and 90 mm/s. Featuring an inorganic Si–O–Si backbone, low surface tension (20–22 mN/m), and high compliance, PDMS crosslinks at ambient conditions (23 °C, 50% RH) without thermal distortion. Motorized dip-coating facilitates capillary infiltration into inter-bead voids, forming a flexible, hydrophobic moisture barrier. Standardized evaluation protocols—including ISO 4287 profilometry, ASTM D2240 Shore D hardness, ASTM D570-98 water absorption, and scanning electron microscopy—are formulated to quantify roughness reduction and sealing efficacy.

Keywords: 3D printing; Acrylonitrile Butadiene Styrene (ABS); Fused Deposition Modeling (FDM); Polydimethylsiloxane (PDMS); Water absorption.

ICEMSET-2026/ST/1242

Collaborative Multi-AI System with Persistent Memory and Role-Based Behavior

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Abstract

Large language models (LLMs) are increasingly used for coding, research, writing, analysis, and software development, but they often lose relevant context during long interactions and when users switch between AI providers. This work presents a collaborative multi-AI system with an application-level persistent memory layer that operates independently of individual AI providers. The system extracts relevant information from conversations, removes redundant memories, stores knowledge as structured records, and retrieves context for subsequent interactions. Retrieved memories are combined with recent messages, persona instructions, and the current query before being sent to the selected provider. A common provider manager integrates ChatGPT, Gemini, Grok, and DeepSeek, while a role-based behavior layer supports personas such as Backend Engineer, Frontend Engineer, DevOps Engineer, and Cloud Engineer. The memory pipeline includes conversation buffering, NLP-based information extraction, memory creation, similarity-based consolidation, persistent storage, and relevant memory retrieval. Experiments evaluate memory footprint, retrieval accuracy, de-duplication, context preservation, persona preservation, and processing latency, demonstrating the feasibility of provider-independent contextual continuity.

Keywords: large language models; persistent memory; conversational AI; multi-AI systems; memory retrieval; role-based AI.

ICEMSET-2026/ST/1243

AI-based Robotic Systems for Smart Garden Monitoring: A Review

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Abstract

Monitoring soil conditions and plant growth is essential for effective garden management; however, most of the techniques usually include repetitive manual measurements or a large number of stationary sensors. The paper examines current technologies of automated garden monitoring, including mobile robots, navigation techniques, multi-parameter soil sensors, artificial intelligence-based plant growth monitoring, and wireless communication systems. Advantages and disadvantages of the examined techniques in the context of practical garden applications are reviewed. Findings indicate that many existing systems focus on individual monitoring functions or operate in controlled environments, limiting their applicability to outdoor gardens. Therefore, variations in environmental conditions and plant characteristics present challenges for reliable monitoring. These findings show the importance of an integrated mobile robotic system that integrates soil condition evaluation, image-based growth-stage detection, and remote monitoring via a mobile application. This review serves as a platform for designing more accessible and effective smart garden monitoring solutions.

Keywords: Smart Gardening; Mobile Robotics; Soil Monitoring; Plant Growth Recognition; Artificial Intelligence.

ICEMSET-2026/ST/1244

Deep Learning for Automated Crop Disease Detection: A Comprehensive Review of Methods, Trends, and Research Challenges

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Abstract

Crop diseases significantly affect agricultural productivity, crop quality, and food security, necessitating rapid and accurate detection systems. This review examines deep learning approaches for image-based crop disease detection, covering model architectures, detection tasks, datasets, evaluation methods, and emerging trends. Analysis of 160 studies published between 2020 and 2025 reveals that classification dominates (67.5%), followed by object detection (18.75%) and segmentation (13.75%). CNNs remain widely used, while YOLO and U-Net are prominent in detection and segmentation, respectively. PlantVillage appears in 41.88% of studies,

highlighting dependence on benchmark datasets. Despite high reported accuracy, practical deployment faces challenges involving dataset bias, domain shift, class imbalance, similar disease symptoms, severity assessment, inconsistent evaluation, and computational costs. Emerging approaches, including Vision Transformers, hybrid architectures, lightweight models, explainable AI, multimodal learning, and edge computing, offer promising solutions. Future research should prioritize diverse field datasets, standardized evaluation, cross-domain validation, interpretability, robustness, computational efficiency, and real-world applicability to develop reliable agricultural decision-support systems.

Keywords: Crop disease detection; Deep learning; Artificial intelligence; Convolutional neural networks.

ICEMSET-2026/ST/1245

Eggshell-Derived Iron-Based Nanocomposites for Dye Degradation and Oil–Water Remediation

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Abstract

The current study is dedicated to the comparative preparation and environmental remediation potential of iron-based nanocomposites prepared using eggshell waste through a bio-assisted approach, alongside an eggshell-free chemical control. Structural and morphological characterization was carried out to determine the influence of the eggshell-derived calcium carbonate matrix on crystal growth, surface properties, and potential catalytic activity. The eggshell-functionalized nanocomposite (FeCO-ES) was evaluated for its potential application in dye degradation through photocatalytic and/or photo-Fenton processes. Its performance was compared with that of the unfunctionalized counterpart to assess the contribution of eggshell-derived components to contaminant removal. The material was further investigated for oil–water separation, with particular emphasis on its potential for the remediation of oil-contaminated wastewater. The performance of the nanocomposite will be correlated with its physicochemical properties and the potential synergistic interactions between iron-containing phases and the eggshell-derived calcium carbonate matrix. In parallel, the development of a bimetallic sodium alginate membrane represents an extension of this research toward polymer-matrix-based separation systems for hazardous contaminants. Together, these approaches aim to explore complementary strategies for environmental remediation by integrating nanoparticle-mediated treatment with membrane-based separation technologies.

ICEMSET-2026/ST/1246

Reconstructing Fire Exposure from Steel

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Abstract

After a fire, the decision to keep or replace a structural steel member hinges on one number: the peak temperature it reached. Today that number comes largely from expert judgement of hardness and microstructure, and it arrives with no stated error. The underlying problem is ill-posed, because hardness records both temperature and exposure time, so a single measurement is consistent with many fires. We propose estimating peak temperature from hardness and micrographs of ferrite-pearlite steel while treating exposure time as unknown. A convolutional neural network, pre-trained on simulated heating cycles, will generate the estimate, and conformal prediction, calibrated on furnace-heated specimens, will convert it into an interval with 90% nominal coverage. We will test whether intervals widen where the evidence is ambiguous, and benchmark against a hardness-only baseline under non-isothermal heating. The aim is an honest account of what the steel can reveal about the fire.

ICEMSET-2026/ST/1247

Development and Characterization of Poly[(4-methyl-5-vinylthiazole) methacrylate-co-butyl methyl methacrylate/ZrO_2 Nanocomposites as Corrosion Coatings

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Abstract

Corrosion poses a serious challenge across various industries, leading to substantial economic losses and reduced material durability. Developing efficient protective coatings is therefore essential for extending the service life of metallic structures. This study investigates the corrosion protection performance of Poly(VTA-co-BMA) and its zirconium dioxide (ZrO_2) nanocomposite coating applied to mild steel. The nanocomposite was synthesized through in-situ solution polymerization to improve the protective characteristics of the polymer matrix. Fourier-transform infrared spectroscopy (FTIR) and X-ray diffraction (XRD) were employed to examine the chemical structure and crystalline properties, while transmission electron microscopy (TEM) and scanning electron microscopy (SEM) were used to study the morphology and nanoparticle distribution. Corrosion resistance was evaluated in a 3.5% (w/v) sodium chloride solution using potentiodynamic polarization and electrochemical impedance spectroscopy (EIS). The investigation aims to assess the potential of ZrO_2 incorporation to enhance the barrier properties and corrosion resistance of polymer-coated mild steel under aggressive environmental conditions.

Keywords: Corrosion Coatings, Nanocomposites, Anti-Corrosive Properties, Electrochemical Impedance Spectroscopy (EIS).

ICEMSET-2026/ST/1248

AI-Driven E-Governance Framework for Automated Tomato Disease Monitoring and Severity-Based Decision Support in Smart Agriculture

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Abstract

This paper proposes an AI-Driven E-Governance Framework for Automated Tomato Disease Monitoring and Severity-Based Decision Support in Smart Agriculture. The proposed framework integrates multi-task deep learning-based tomato disease detection and severity assessment with explainable artificial intelligence, farmer advisory services, government monitoring dashboards, and policy decision-support mechanisms. The framework establishes a unified ecosystem that enables real-time disease surveillance, district-level disease intelligence, severity-based intervention planning, and data-driven agricultural governance. The proposed architecture consists of seven interconnected layers: image acquisition, disease analytics, severity assessment, explainable AI, farmer advisory services, government monitoring dashboards, and e-governance decision support. By bridging the gap between AI-enabled plant disease analytics and agricultural governance, the proposed framework aims to improve crop health management, enhance farmer decision-making, support evidence-based policymaking, and contribute toward sustainable smart agriculture.

ICEMSET-2026/ST/1249

Comparative Evaluation of Chemically Synthesized and *Sargassum*-Mediated Green-Synthesized ZnO Nanoparticles: Antibacterial, Antioxidant, and Catalytic Activities

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Abstract

This study presents a comparative investigation of zinc oxide (ZnO) nanoparticles synthesized using a conventional chemical approach and a green synthesis route mediated by the brown macroalga *Sargassum*. The

study aims to evaluate the influence of the synthesis method on the functional performance of the resulting nanomaterials. The synthesized nanoparticles were assessed for their antibacterial activity against selected bacterial strains, antioxidant potential, and catalytic performance. The comparison provides insight into how algal-derived biomolecules may influence nanoparticle formation, surface characteristics, and functional properties. Green synthesis offers a potentially more sustainable alternative to conventional chemical preparation by reducing reliance on additional chemical reagents. By integrating antibacterial, antioxidant, and catalytic assessments, this work explores the potential advantages of *Sargassum*-mediated ZnO nanoparticles for environmental and biomedical applications. The findings are intended to establish the relationship between synthesis strategy and multifunctional performance.

Keywords: Zinc oxide nanoparticles; Green synthesis; *Sargassum*; Antibacterial activity; Antioxidant activity; Catalytic activity.

ICEMSET-2026/ST/1250

The Design and Optimization of a Leaf-Inspired High-Efficiency Solar Still

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Abstract

The Design and Optimization of a Leaf-Inspired High-Efficiency Solar Still presents a sustainable desalination approach that uses the natural structure and water-management characteristics of leaves to improve solar-driven freshwater production. The proposed system is designed to enhance the collection and evaporation of saline or contaminated water by incorporating a leaf-inspired surface geometry that promotes better water spreading, solar energy absorption, and condensate collection. Solar radiation supplies the thermal energy required for water evaporation. Key operating parameters such as solar intensity, water depth, absorber temperature, evaporation rate, and freshwater yield are considered during system optimization. The performance of the proposed solar still can be evaluated using daily freshwater production, thermal efficiency, and overall water productivity under different operating conditions. The design aims to provide a low-cost, environmentally friendly, and energy-independent solution for freshwater generation, particularly for regions where conventional desalination methods are expensive or difficult to implement.

Keywords: Leaf-inspired design, solar still, solar desalination, freshwater production, biomimetic technology, evaporation, condensation, thermal efficiency, water purification, renewable energy.

ICEMSET-2026/ST/1251

FixItNow: A Hyperlocal AI-Powered Marketplace for Blue-Collar Worker Dispatch Using YOLOv8 Object Detection

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Abstract

Homeowners in India's tier-1 and tier-2 cities struggle to describe household problems well enough for a platform to send the right worker, so manual, text-based categorisation causes misrouted jobs and repeat visits. We present FixItNow, a hyperlocal marketplace that automates this step through visual problem detection. A homeowner uploads a photo or short video; YOLOv8 models fine-tuned by transfer learning on Roboflow Universe datasets classify the damage as Masonry, Plumbing or Mobile Screen Damage, and the nearest available worker of that trade is matched. The detection pipeline runs as a separate FastAPI micro-service, trained on a consumer laptop GPU (NVIDIA RTX 3050) and connected to a Next.js/Node.js application backed by Supabase. Masonry achieved 83.4% mAP@0.5, Plumbing 51.2% and Mobile Screen Damage 40.1%,

reflecting differences in training data and defect subtlety. Tests on real photos and videos, including a phone over a local network, confirmed the pipeline works end to end.

Keywords: YOLOv8; Object Detection; Hyperlocal Marketplace; Transfer Learning; Blue-Collar Worker Dispatch.

ICEMSET-2026/ST/1252

YOLOv5-Based Arecanut Spoilage Detection and Classification Using Computer Vision

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Abstract

Fungal spoilage lowers the quality and market value of arecanuts, and manual inspection is slow and inconsistent. This study detects and classifies healthy and spoiled arecanuts automatically from ordinary photographs. A dataset of 600 images (300 healthy and 300 spoiled nuts showing green fungal growth) was captured with a smartphone and labelled with bounding boxes. A YOLOv5 object detection model was trained on it, and a Python program applies the best weights, removes weak and duplicate detections, and labels each nut as healthy or spoiled. On 1,000 separate test samples, the method reached an accuracy of 96.4%, a precision of 95.8%, and a recall of 97.0% for spoiled nuts, processing each image in 38.5 milliseconds. Accuracy stayed within 1.5% across lighting from 200 to 1000 lux. The results show that fungal spoilage in arecanuts can be identified reliably from images, offering a low-cost basis for automated quality inspection.

Keywords: Arecanut; Spoilage detection; Fungal growth; YOLOv5; Computer vision.

ICEMSET-2026/ST/1253

Performance Optimization of Quantum Error Correction under Resource Constraints for Agriculture

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Abstract

Efficient irrigation scheduling is an important agricultural problem involving the allocation of limited water resources according to crop requirements and water availability. Quantum computing offers potential approaches for solving such optimization problems, however, noise in quantum operations and decoherence can affect computational reliability. Quantum error correction (QEC) addresses these limitations by encoding logical qubits into multiple physical qubits and detecting errors through syndrome measurements, supporting more reliable execution of quantum algorithms. The implementation of QEC introduces additional physical qubits, quantum gates and measurement operations, creating a trade-off between computational reliability and resource overhead. This paper proposes an evaluation framework that connects quantum error correction with irrigation scheduling under water-resource constraints. Selected QEC schemes are evaluated under different physical noise conditions using logical error rates, physical-qubit overhead and quantum operation requirements as performance measures. The study aims to assess how error correction affects the reliability and resource cost of quantum computations associated with irrigation scheduling, identifying configurations that balance error suppression with resource efficiency.

Keywords: Quantum Error Correction; Agricultural Optimization; Irrigation Scheduling; Fault-Tolerant Quantum Computing; Quantum Noise.

ICEMSET-2026/ST/1254

Edge-AI Automated Peripheral Blood Smear Analysis

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Abstract

Rural and resource-limited clinics often lack access to automated haematology analysers and instead rely on tedious manual slide microscopy. In response, we developed a standalone edge-AI screening platform pairing a conventional optical microscope with a 12.3 MP camera and a Raspberry Pi 4B. By deploying an INT8-quantized YOLOv8n detector via ONNX Runtime, the system processes smear fields at ≈ 4.1 FPS directly on the host CPU. Benchmarking against the public BCCD dataset yielded 0.856 mAP@0.5, with class F1 scores of 0.98 for leukocytes, 0.84 for platelets, and 0.65 for erythrocytes. Evaluation across independent clinical smears exposed acute platelet sensitivity to staining shifts, while method-comparison statistics diagnosed clear boundary-truncation limits in erythrocyte agreement. These results demonstrate that sub-$300 offline edge computing can deliver viable point-of-care cytology triage, establishing empirical operational benchmarks for future multi-centre validation.

Keywords: Edge AI; Blood Cell Detection; YOLOv8; Medical Image Analysis; Raspberry Pi.

ICEMSET-2026/ST/1255

MRI Brain Tumor Detection and Segmentation: Traditional Methods and Deep Learning Approaches

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Abstract

Precise identification and segmentation of brain tumors in magnetic resonance imaging (MRI) is of critical importance for diagnosis, treatment planning and longitudinal follow-up. The clinical reference standard is manual segmentation of subregions of the tumor by radiologists, which is time consuming, subjective and difficult to repeat for big datasets. In this paper a short survey is presented, which relates classical brain tumor detection methods based on image processing techniques (thresholding, watershed transformation, symmetry-based analysis and clustering) to recent deep learning methods based on convolutional neural network (CNN) techniques. Here, we evaluate preprocessing pipelines, key segmentation algorithms and common post-processing operations, and emphasize their strengths, limits and typical application scenarios in MRI. We also highlight practical issues such as unpredictability in tumor appearance, class imbalance, lack of annotated 3D datasets and the need for clinically interpretable models. Finally, we highlight open research avenues in robust multimodal MRI segmentation, uncertainty quantification, and the incorporation of automated techniques into computer-aided diagnosis pipelines.

Keywords: Brain tumor, MRI, Deep learning, Image segmentation, Convolutional neural networks, Computer aided diagnosis.

ICEMSET-2026/ST/1256

A Conceptual Food-System Framework for Sustainable Mitigation of Per- and Polyfluoroalkyl Substances (PFAS) in Food and Food-Contact Materials

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Abstract

Per- and polyfluoroalkyl substances (PFAS), also called forever chemicals, are man-made pollutants that are ubiquitously present in the environment and enter the human body mainly with food; they may originate from water, soil, crops, marine species, and food contact materials. Detecting PFAS does not necessarily prevent their introduction into the food chain or indicate the most appropriate intervention strategy. This article proposes an innovative framework for evaluating sustainable PFAS mitigation within the food system based on regulatory analysis and a comparison of three different approaches: controlling contamination sources, replacing food contact materials containing PFAS with safer alternatives, and assessing treatment technologies for water and other materials. The evidence on the reduction of contaminants, scope of affected compounds, food contact safety, food quality, cost, environmental impact, and residue management was compared and discussed with a focus on the limitations of water treatment technologies' adaptation to food processing. The developed framework establishes links between contamination sources and potential interventions, facilitates the selection of safer processing and packing alternatives, and guides future research on PFAS mitigation.

Keywords: PFAS; food safety; food-contact materials; sustainable mitigation; risk reduction.

ICEMSET-2026/ST/1257

Voice-Controlled Home Automation System Using Bluetooth Communication and Digital Logic

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Abstract

This project presents a voice-controlled home automation system in which voice commands are converted into digital signals through speech-to-text processing. The commands are transmitted to a microcontroller via Bluetooth. Acting as the central processing unit, the microcontroller analyzes the digital inputs and controls the output pins according to predefined logic. These outputs drive relays that function as digital switches for operating home appliances. Each command is interpreted as a binary state, where '1' turns a device ON and '0' turns it OFF. The system demonstrates the practical application of digital logic by bridging voice input and digital control. It also illustrates the integration of Bluetooth communication, automatic speech recognition, digital signal processing, and microcontroller-based control for home automation.

Keywords: Bluetooth Communication; Internet of Things (IoT); Automatic Speech Recognition (ASR); Digital Signal Processing (DSP); Home Automation.

ICEMSET-2026/ST/1258

An Evaluation and Study of Load Optimization Strategies for Integrated Sun-Wind Intelligent Power Networks

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Abstract

Increasing electricity demand and environmental issues have laid down the need of shifting toward utilization of renewable energy (RE) for sustainable power generation. In available renewable resources, solar energy (SE) and wind energy (WE) are widely adopted because their generation patterns complement each other. However, their variable output creates challenges for reliable power system operation. Load optimisation strategies or Demand-Side-Management (DSM) helps address these challenges by improving load scheduling, increasing

energy utilization and supporting renewable energy integration. This paper reviews the application of DSM in Hybrid-Renewable-Energy-Systems (HRES) for smart grid applications. The review covers Load optimisation strategies, mathematical modeling of solar and wind energy systems, optimum sizing methods, reliability assessment, system topologies, integration benefits and recent developments in HRES. The study shows that the combined use of DSM and HRES improves renewable energy utilization, enhances system reliability and operational flexibility, reduces operating costs and supports the development of sustainable smart grids.

Keywords: DSM; HRES; Photovoltaic; Wind Energy; Load optimisation.

ICEMSET-2026/ST/1259

BlueTalk: An Adaptive Communication Framework for Disaster Resilience

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Abstract

Natural disasters often disrupt cellular networks and internet connectivity, making communication difficult during emergency response. Existing solutions may require specialized hardware or reliable network infrastructure, limiting their accessibility in disaster-affected areas. This paper presents BlueTalk, an open-source, offline-first communication framework designed for Android and iOS smartphones. The proposed system integrates Bluetooth Low Energy (BLE) peer-to-peer communication, multi-hop message relaying, and end-to-end encryption to support the exchange of text, voice, images, and files without internet access. A dual-transport approach enables communication through Bluetooth when offline and internet-based messaging when connectivity is available. Additional features include SOS alerts, offline verification of rescue personnel, and an on-device language model for disaster-related guidance. The framework aims to improve communication reliability, privacy, and accessibility in infrastructure-constrained environments. We evaluated the system using 3 disaster scenarios across a 4-node mesh topology. Results show a delivery ratio of 95.1%, latency of 710 ms over 3 hops, and battery use of 3.1% per hour, outperforming existing approaches by 62.4%.

ICEMSET-2026/ST/1260

Taguchi-Based Optimizations of Melt Flow Index for Nylon 6–Mica Composite FDM Filaments

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Abstract

This paper presents a systematic investigation of the Melt Flow Index (MFI) characteristics of Nylon 6 Muscovite Mica Polymer Matrix Composite (PMC) filaments developed for Fused Deposition Modelling (FDM) applications. Three composite formulations — F1 (90:10), F2 (80:20), and F3 (70:30) Nylon 6:Mica by weight — were synthesised via twin-screw melt compounding and their processability was characterised using the Taguchi L9 Design of Experiments (DOE) methodology with ANOVA. Three process factors were investigated: extrusion temperature (230–250 °C), extrusion load (2.16–5.00 kg), and mica proportion (20–40 wt%). MFI values ranged from 2.84 to 10.34 g/10 min across the experimental matrix. ANOVA identified extrusion load as the dominant parameter (72.0% contribution), followed by mica proportion (27.0%), and temperature (1.0%). The optimal condition for minimum MFI was: 230 °C / 2.16 kg / 40 wt% mica. Continuous 1.75 mm diameter filaments fabricated under optimised single-screw extrusion parameters (Zones 170/180/190/190 °C, 15 rpm) achieved diameter consistency within ±0.05 mm, confirming FDM-grade processability.

Keywords: Fused Deposition Modelling (FDM), Nylon 6, Muscovite Mica, Melt Flow Index (MFI), Taguchi DOE, Additive Manufacturing.

ICEMSET-2026/ST/1261

Mechanical, Thermal, and Microstructural Characterization of Nylon 6–Mica Composite FDM Filaments and 3D-Printed Specimens

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Abstract

This paper reports a comprehensive multi-scale characterizations of Nylon 6–Muscovite Mica Polymer Matrix Composite (PMC) FDM filaments and 3D-printed specimens across three mica weight-fraction formulations: F1 (90:10), F2 (80:20), and F3 (70:30) Nylon 6:Mica. ASTM D638 compliant tensile dog-bone specimens were 3D printed on a standard commercial FDM platform (Accucraft i250D, 250 °C nozzle, 80 °C bed) without hardware modification, and tested at IRMRA, Thane. The 70:30 formulation achieved the highest tensile strength of 411 kg/cm² (40.3 MPa), surpassing the commercial ABS benchmark (369 kg/cm², 36.2 MPa) by 11.4%. The 80:20 formulation exhibited the optimal combination of tensile strength (373 kg/cm²) and elongation at break (55%), significantly exceeding ABS (7%). DSC analysis per ASTM D3418 confirmed monotonic elevation of peak melting temperature from 216.89 °C (F1) to 223.46 °C (F3), attributable to heterogeneous nucleation activity of mica platelet surfaces. SEM cross-sectional analysis at 145× and 1,000× magnification revealed homogeneous mica dispersion at 10 and 20 wt% loadings, with incipient agglomeration observed at 30 wt%, mechanistically correlating with the reduction in elongation at break from F2 to F3. The 80:20 formulation is recommended as the optimal composition for engineering FDM applications.

Keywords: Thermal Analysis, Nylon 6, Muscovite Mica, Polymer, Matrix Composite, Additive Manufacturing.

ICEMSET-2026/ST/1262

A review on Single-Layer MXenes: Synthesis Strategies, Delamination Mechanisms, Properties, and Challenges

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Abstract

Since the discovery of the MXenes in 2011 there has been a huge amount of work in the field aimed at developing efficient and economical routes to their synthesis. The standard approach to MXene synthesis is the selective etching of the A layer from the MAX phase (e.g. Ti_3AlC_2) followed by delamination to produce the single layer flakes. The MAX phases themselves have a very attractive combination of metallic and ceramic properties (electrical conductivity, thermal stability, mechanical strength etc). MXenes have high electrical conductivity, are hydrophilic, have tunable surface terminations, have a large specific surface area, and are excellent charge transporters. Single-layer MXenes have several advantages over multilayer forms: they minimize interlayer sliding, improve surface accessibility, and enable stable colloidal dispersions. This review looks at the recent advances in MAX phase etching, MXene delamination, synthesis optimization, and characterization with a view to highlighting the properties, potential applications, and key issues associated with single-layer MXenes as opposed to the multilayer forms.

Keywords: MAX Phase; MAXene; Selective etching; Surface terminations.

ICEMSET-2026/ST/1263

Smart Car System Using Vision-Based Gesture Recognition, Multi-Factor Authentication, and Automatic Parking

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Abstract

The rapid advancement of embedded systems, artificial intelligence, and automation technologies has enabled the development of intelligent vehicle systems that improve security, convenience, and operational efficiency. This paper presents a Smart Car System Using Vision-Based Gesture Recognition, Multi-Factor Authentication, and Automatic Parking, integrating touchless interaction, biometric security, and automated parking into a unified embedded platform. An ESP32 microcontroller is used as the central controller, while an ESP32-CAM module performs face recognition and vision-based gesture detection. Multi-factor authentication is implemented using face recognition and fingerprint verification to restrict vehicle access to authorized users. Ultrasonic sensors are employed for obstacle detection and automatic parking, with motor drivers and servomotors controlling vehicle movement and steering. The system processes camera and sensor inputs in real time and generates appropriate control actions, enabling functions such as touchless locking and unlocking and assisted vehicle parking in constrained spaces. The proposed integration improves security and usability while reducing dependence on conventional physical access mechanisms. The expected outcome is a cost-effective smart car prototype capable of demonstrating secure authentication, gesture-based control, obstacle detection, and automatic parking. The system also provides a foundation for future enhancements, including Internet of Things (IoT) connectivity, cloud-based authentication, and advanced artificial intelligence-based vehicle automation.

Keywords: smart car, ESP32, ESP32-CAM, gesture recognition, face recognition, fingerprint authentication, automatic parking, computer vision, embedded systems.

ICEMSET-2026/ST/1264

Adaptive LVRT Control for Grid-Connected Solar PV Inverters Based on Voltage Sag Magnitude and Inverter Current Limit

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Abstract

This paper presents an adaptive Low-Voltage Ride-Through (LVRT) control strategy for a grid-connected solar photovoltaic (PV) inverter that responds to variations in grid-voltage sag and the available inverter current limit. The proposed system consists of a PV array, DC–DC converter with MPPT, DC-link capacitor, three-phase voltage source inverter, LCL filter, and grid interface. Grid voltage and inverter current are continuously measured using voltage and current sensors and supplied to the adaptive LVRT control scheme. During a voltage sag, the controller determines the sag condition and adjusts the inverter control action while maintaining the current within its allowable limit. The resulting control signals are processed through the PWM generator and gate driver to regulate the inverter switching operation. By coordinating voltage-sag information with the inverter current constraint, the proposed approach aims to maintain stable grid-connected operation, provide appropriate reactive-current support, and reduce excessive inverter current during abnormal grid conditions. The proposed control structure provides a practical approach for improving the LVRT capability of solar PV inverters under different grid-voltage sag conditions.

Keywords: Adaptive LVRT control, Solar PV system, Grid-connected inverter, Voltage sag, Inverter current limit, Reactive current support, Three-phase VSI, LCL filter, MPPT, PWM control.

ICEMSET-2026/ST/1265

Samarium-Induced Microstructural Modulation and Enhanced Energy Storage Efficiency in $BaTi_{0.965}Sn_{0.035}O_3$ Ceramics

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Abstract

The influence of samarium Sm^{3+} incorporation on the structural, vibrational, and energy-storage performance of $BaTi_{0.965}Sn_{0.035}O_3$ (BTS) lead-free ceramics was systematically investigated. A series of $Ba_{1-x}Sm_xTi_{0.965}Sn_{0.035}O_3$

compositions (x = 0, 0.025, 0.050, and 0.075, designated as BTS, S25, S50, and S75, respectively) were successfully synthesized and characterized using Fourier-transform infrared (FTIR) spectroscopy, Raman spectroscopy, and room-temperature polarization–electric field (P–E) hysteresis measurements. FTIR spectra confirm the retention of the primary perovskite structure through characteristic Ti–O stretching and bending vibrational modes. Raman spectroscopy reveals systematic shifts in peak positions, intensity variations, and band broadening, signifying localized lattice distortions and defect-induced vibrational behaviour resulting from Sm^{3+} substitution. With progressive Sm doping, the P–E loops exhibit significant narrowing, accompanied by a marked reduction in remnant polarization and energy loss. Among the investigated compositions, the optimized S50 ceramic demonstrates exceptional energy-storage performance, achieving a low remnant polarization of 0.05 μC cm^{-2}, a small coercive field of 0.13 kV cm^{-1}, and an outstanding energy-storage efficiency of 86.06% (compared to 50.13% for pristine BTS). Furthermore, the dielectric breakdown strength increases substantially from 9 to 25 kV cm^{-1}, highlighting the immense potential of Sm-modified BTS ceramics for advanced, high-efficiency capacitive energy-storage applications.

Keywords: Lead-free ceramics; Raman spectroscopy; FTIR; Energy storage; Polarization.

ICEMSET-2026/ST/1266

Video Based Two-Wheeler Driving Skill Validation System Using Deep Learning

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Abstract

Traditional two-wheeler driving tests depend on brief observation by a human examiner, which is inconsistent and offers limited structured evidence. This paper presents a video-based driving skill validation system that integrates candidate authentication, computer vision, pose analysis, machine learning, rule-based scoring, and automated reporting. Facial authentication links each driving session to a registered candidate. Test videos are processed using YOLOv8 for rider and motorcycle detection, OpenCV for lane analysis, and MediaPipe Pose for rider landmark analysis. Session-level behavioral features are classified by Random Forest and Support Vector Machine (SVM) models, and a rule-based scoring layer produces the final pass/fail result. Flask and SQLite handle web-based processing and storage, and ReportLab generates PDF reports. On a synthetic dataset of 1000 records, both classifiers achieved 100% accuracy, precision, recall, and F1-score using a stratified 80:20 split. Because the labels derive from deterministic rules, these results validate only the implementation, not real-world accuracy.

Keywords: Two-wheeler driving assessment; Computer vision; YOLOv8; MediaPipe Pose; Random Forest; Support Vector Machine.

ICEMSET-2026/ST/1267

EcoCart: A Sustainability-Aware E-Commerce Framework for Curating Eco-Friendly Products and Promoting Responsible Consumption

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Abstract

Mainstream e-commerce platforms rank products almost exclusively by price, popularity and predicted click probability, so a shopper who wants to buy responsibly has no reliable signal to act on: sustainability claims are scattered across unverified marketing copy, certification data is not machine readable, and the environmental cost of packaging and last-mile delivery is never exposed at the point of decision. This paper presents EcoCart, a sustainability-aware e-commerce framework that makes environmental quality a first-class ranking signal. A React front end backed by a Node.js/Express commerce service, a Spring Boot catalogue and order service and a Flask analyt-ics service ingests product, certification, material and logistics metadata, normalises heterogeneous attributes into a composite EcoScore built with an analytic-hierarchy-process weighting, esti-mates a per-order carbon footprint from packaging and shipping parameters, and screens vague claims with a transformer-based

greenwashing detector that discounts unverifiable assertions. A hybrid recommender combines content similarity over material and certification embeddings with implicit-feedback collaborative filtering, and a sustainability-aware re-ranking stage trades a small amount of relevance for a large gain in the greenness of the recommended set, with the trade-off strength adapted per user from observed green affinity. On a catalogue of 18,540 products and 62,310 interactions, EcoCart reaches Precision@10 of 0.341, NDCG@10 of 0.398 and a green-share of 68.4% in the top-10 list against 31.2% for a LightGCN baseline, while the greenwashing classifier attains 93.7% accuracy and the API responds in 148 ms at the 95th percentile under 500 concurrent users. An ablation confirms that the EcoScore, the credibility penalty and the adaptive re-ranker contribute independently.

Keywords: Sustainable e-commerce, green consumerism, EcoScore, recommender systems, greenwashing detection, carbon footprint, MERN stack, React, Node.js, Flask, Spring Boot, microservices.

ICEMSET-2026/ST/1268

Smart Car System Using Vision-Based Gesture Recognition, Multi-Factor Authentication, and Automatic Parking

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Abstract

The rapid advancement of embedded systems, artificial intelligence, and automation technologies has enabled the development of intelligent vehicle systems that improve security, convenience, and operational efficiency. This paper presents a Smart Car System Using Vision-Based Gesture Recognition, Multi-Factor Authentication, and Automatic Parking, integrating touchless interaction, biometric security, and automated parking into a unified embedded platform. An ESP32 microcontroller is used as the central controller, while an ESP32-CAM module performs face recognition and vision-based gesture detection. Multi-factor authentication is implemented using face recognition and fingerprint verification to restrict vehicle access to authorized users. Ultrasonic sensors are employed for obstacle detection and automatic parking, with motor drivers and servomotors controlling vehicle movement and steering. The system processes camera and sensor inputs in real time and generates appropriate control actions, enabling functions such as touchless locking and unlocking and assisted vehicle parking in constrained spaces. The proposed integration improves security and usability while reducing dependence on conventional physical access mechanisms. The expected outcome is a cost-effective smart car prototype capable of demonstrating secure authentication, gesture-based control, obstacle detection, and automatic parking. The system also provides a foundation for future enhancements, including Internet of Things (IoT) connectivity, cloud-based authentication, and advanced artificial intelligence-based vehicle automation.

Keywords: smart car, ESP32, ESP32-CAM, gesture recognition, face recognition, fingerprint authentication, automatic parking, computer vision, embedded systems.

ICEMSET-2026/ST/1269

Digital Twin-Based Edge AI Framework for Early Thermal Runaway Detection in Electric Vehicle Batteries Using Mobilenetv

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Abstract

The thermal safety of lithium-ion batteries in electric vehicles is an important issue as abnormal heat generation can develop into thermal runaway. This paper proposes an Edge AI framework based on Digital Twin for classifying EV battery thermal conditions from thermal images. The thermal data is collected using an MLX90640 infrared thermal camera with a resolution of 32 × 24 pixels. The thermal data is converted into

image inputs and classified into three classes of Normal, Warning, and Thermal Runaway. Pre-processing of images with OpenCV and classification with MobileNetV2. The trained model is converted to TensorFlow Lite for lightweight inference and the classification output is integrated into a Streamlit-based Digital Twin dashboard. The thermal condition is shown on the dashboard with temperature visualisation and simulated Voltage, Current, State of Charge (SoC) and State of Health (SoH) values for software demonstration. A dataset of 900 thermal images, with 300 images for each class, is used for model development. The implemented classifier classified all samples correctly on a held out test set of 135 images. The results show that it is feasible to integrate thermal image classification, lightweight inference and Digital Twin visualisation in an integrated EV battery monitoring workflow.

Keywords: Electric vehicle, thermal runaway, thermal imaging, MobileNetV2, Edge AI, TensorFlow Lite, Digital Twin, battery monitoring.

ICEMSET-2026/ST/1270

Agribot-Intelligent Farm Surface Management System for Autonomous Kusa Grass Removal

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Abstract

In this work, an Automatic Kusha Cutting Robot for Agricultural Fields is proposed to reduce manual effort and improve the efficiency of unwanted grass removal. The proposed system combines grass detection, grass height measurement, obstacle detection, automatic movement, and cutting mechanisms to perform grass removal with minimal human intervention. The robot detects the presence and height of Kusha grass and automatically cuts it approximately 2–3 cm above the ground. A conveyor mechanism transfers the cut grass into a rear collection box for easy collection. An ultrasonic sensor is used to detect obstacles and support safe navigation, while a solar-powered battery system provides energy for the robot's operation. The robot can also be monitored through a mobile interface, allowing farmers to observe its working status remotely. The proposed system is designed as a cost-effective, eco-friendly, and practical solution for reducing labour requirements, cutting time, and dependency on manual grass removal in agricultural fields.

Keywords: Automatic Grass Cutting Robot, Kusha Grass, Agricultural Automation, Grass Height Detection, Obstacle Detection, Solar Power, Mobile Monitoring, Smart Agriculture.

ICEMSET-2026/ST/1271

Design and Development of a Compact Six-Pack Cockpit Instrument

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Abstract

Accurate measurement of basic flight parameters is essential for effective aircraft flight instrumentation and pilot awareness. Conventional cockpit instruments such as the airspeed indicator and altimeter depend on pressure and motion obtained through dedicated sensing systems. This project focuses on the development of a compact digital flight instrumentation system that reproduces key flight parameters using electronically acquired sensor data. A custom Pitot static arrangement is developed to obtain the total and static pressure required for airspeed instrument. Then processed by a microcontroller to calculate airspeed. In parallel, a barometric pressure sensor is used to determine altitude, while inertial sensing is used to obtain aircraft motion parameters. The acquired sensor data are processed and converted into corresponding flight instrument readings, which are presented through a digital cockpit interface. The proposed system aims to demonstrate the practical development of aircraft instrumentation starting from the physical measurement of flight parameters, followed

by electronic data acquisition, processing and digital display. The system also provides a platform for evaluating the accuracy and response of the developed Pitot-static airspeed measurement against reference measurements. The overall objective is to develop and experimentally evaluate a low cost, compact 6 pack digital instrumentation system that demonstrates the fundamental principles of aircraft flight instrumentation using a self-developed measurement arrangement.

ICEMSET-2026/ST/1272

Effect of Zr and Sn Doping on Structural Properties of $CaTiO_3$ Perovskite oxide for Photocatalysis Application

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Abstract

Today, the whole world faces the challenges of water purification and green energy production. To tackle this challenge perovskite oxide, plays a vital role due to its tunable band gap and structural stability. The material was synthesised using solid-state reaction method. X-ray diffraction analysis confirmed the single-phase purity of the synthesized samples. Rietveld refinement revealed that the space group was *Pbnm* (62) with orthorhombic crystal structure. The average crystallite size of the prepared sample decreases with increasing the doping of Sn and decreasing the doping of Zr up to Sn=0.04 and Zr = 0.11, increased for Sn = 0.06 and Zr = 0.09. The lattice parameters and volume of the unit cell determined via the refinement changed slightly. FE-SEM gave the morphology and porosity of the sample while EDX confirmed the required elements present in the sample. In Raman spectra peak observed at 682.17 cm^{-1} eliminated completely with the doping of Zr and Sn. After doping the transmission spectra in FTIR within the region of 450-1500 cm^{-1} shifts towards the lower wave number side. This material would be a promising candidate for photocatalysis purposes.

Keywords: $CaTiO_3$ Perovskite Oxide, Zr and Sn doping Solid State method, X-ray Diffraction, Rietveld, FE-SEM, Raman Spectra, FTIR.

ICEMSET-2026/ST/1273

Exploring the Effects of Ti Antisite Defects on the Electronic, Magnetic, Dynamical, and Mechanical Properties of the TiCoSb Half-Heusler Compound: A First-Principles Study

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Abstract

Half-Heusler (HH) compounds have potential applications in the field of device applications. In the present work, we explored the physical properties of TiCoSb and Ti substitution defects in TiCoSb (i.e. TiTiSb) HH compounds using the spin-polarized density functional theory (DFT) method within the Vienna Ab-initio Simulation Package (VASP) computational software. It is found that both HH compounds are structurally, mechanically, and dynamically stable. It is also found that both compounds have a ductile nature, and atoms in both structures exhibit metallic-like bonding. Through the analysis of material's band structures, DoS, and PDoS plots, pristine TiCoSb shows semiconducting-nonmagnetic properties, while TiTiSb compound exhibits metallic and magnetic properties. Thus, Ti substitution defects in TiCoSb affect the material's electronic and magnetic properties. The non-magnetic and semiconducting TiCoSb HH compound changes into a magnetic and metallic compound because of Ti substitution defects in the TiCoSb structure. Consequently, novel physical properties are tuned in the defected compound.

Keywords: defect, DFT, dynamical, electronic, half-Heusler, magnetic.

ICEMSET-2026/ST/1274

Synthesis, Characterization, and Green Synthetic Evaluation of Graphene Oxide and Ferric Oxide Nanocomposite Synthesized Using Fresh Juice Extract Of Ananas Comosus

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Abstract

A Green synthesis is gradually used as an alternative method for preparing nanoparticles. In this study, fresh juice extract of Ananas comosus was used to synthesize graphene oxide (GO) and ferric oxide (Fe_2O_3) nanocomposite. The prepared materials were characterized using UV, FT-IR, XRD, FE-SEM, HR-TEM, TGA, BET Adsorotion Isotherm, Zeta Potential and DLS techniques. Its application as a reusable nanocatalyst for iron catalyzed reaction of spirooxiindolethiazolo[3,2-a]pyrimidine derivatives .This protocol comprises without solvent, small amount of iron loading, effective simplicity, and high yield of desired products in less time and diverse substrate possibility. Catalyst separation from reaction medium is very relaxed and its recycling up to four consecutive runs without significant loss in the yield of the product are other significant quality of this method. The optimized reaction conditions were then explored successfully to get up to 97% yield of the desired product at gram scale equal. Compounds are well characterized using FT-IR,^{1}H-NMR, ^{13}C-NMR and HR-MS techniques.

Keywords: Ananas comosus, green nanocomposite, spirooxiindolethiazolopyrimidine derivatives.

ICEMSET-2026/ST/1275

Design and Electrochemical Evaluation of Multifunctional MoO_3- as an Efficient Material for Energy Harvesting and Advanced Supercapacitor/Lithium-Ion Battery Storage Systems

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Abstract

The development of multifunctional electrode materials capable of supporting diverse renewable energy conversion and storage technologies is essential for advancing next-generation energy systems. In this study, molybdenum trioxide (MoO_3) nanorods were synthesized through a facile hydrothermal method and systematically investigated for their potential in dye-sensitized solar cells (DSSCs), supercapacitors, and lithium-ion batteries (LIBs). MoO_3 as a counter-electrode material in DSSCs, achieved a power conversion efficiency of 5.91%, demonstrating the suitability of MoO_3 as an alternative counter-electrode material. In addition to its photovoltaic application, the synthesized MoO_3 nanostructures were employed as active electrodes for electrochemical energy-storage devices. The MoO_3-based supercapacitor exhibited a specific capacitance of 168.75 F g^{-1} at a current density of 1.5 A g^{-1}, and as an anode material for LIBs, the MoO_3 electrode delivered a specific discharge capacity of 730 mAh g^{-1}, highlighting its potential as a high-capacity alternative to conventional graphite-based anodes. Overall, the results demonstrate that hydrothermally synthesized MoO_3 nanorods can serve as a versatile material for both energy conversion and energy-storage applications. This multifunctional approach highlights the potential of MoO_3-based nanostructures for the development of advanced and sustainable energy technologies.

Keywords: MoO_3 thin films, cost effective synthesis, DSSCs, Supercapacitors, Lithium-ion batteries etc.

ICEMSET-2026/ST/1276

Biogenesis of Titania Nanomaterial for Wastewater Treatment

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Abstract

Herein, we report a green, sustainable, and eco-friendly biogenesis of titania (TiO_2) nanomaterials utilizing natural mucilage extracted from jackfruit (*Artocarpus heterophyllus* Lam.) as a robust reducing, capping, and stabilizing agent. The synthesized nanoparticles were comprehensively characterized using UV-Visible spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, X-ray diffraction (XRD), and Scanning Electron Microscopy (SEM). The UV-Vis spectrum exhibited a characteristic absorption edge in the ultraviolet region, confirming the formation of TiO_2. FTIR analysis revealed the presence of functional groups from the mucilage involved in the stabilization of the metal oxides, while XRD patterns confirmed the crystalline nature and phase purity of the nanoparticles. Morphological assessment via SEM indicated spherical aggregates with controlled particle dimensions. This biogenic framework highlights the prospective utilization of biopolymer-rich agro-wastes in fabricating advanced nanomaterials for environmental applications.

Keywords: Biogenesis, TiO_2 nanoparticles, Jackfruit mucilage.

ICEMSET-2026/ST/1277

Design and Simulation of a Dual-Gate HfO_2 Based Organic HEMT for Glucose Sensing Application

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Abstract

This study explores a dual-gate organic transistor designed for low-voltage chemical and biosensing applications using hafnium oxide (HfO_2) as a high-dielectric-constant gate material. The device combines an organic semiconductor channel with two independently controlled gates, allowing better control of channel conduction and threshold voltage. A physics-based simulation framework was developed to study the output and transfer characteristics, threshold-voltage tuning, dielectric-thickness effects, transconductance, carrier mobility, and changes in drain current caused by analyte detection. Glucose sensing was also investigated through a glucose oxidase functionalization model, where analyte binding at the interface was represented by a shift in threshold voltage due to electrostatic effects. The simulations helped clarify how gate bias, dielectric thickness, and threshold-voltage changes affect transistor performance and sensing response. The results highlight the importance of combining dual-gate control with a high-dielectric-constant material to achieve effective channel modulation at lower operating voltages. This work provides useful insights for designing flexible, low-power organic transistor devices for future chemical and biosensing applications.

Keywords: Organic HEMT, high-κ dielectric, TIPS-pentacene, glucose sensing, current–voltage characteristics.

ICEMSET-2026/ST/1278

Design and CFD Analysis of Aerodynamic Drag Reduction Techniques of High-Speed Cars

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Abstract

Aerodynamic drag plays a critical role in the process of understanding vehicle efficiency, potential energy consumption, and vehicle performance in high-speed applications. As speed increases, resisting air enhances the energy requirements. Therefore, this paper emphasizes the computer-based design and computational fluid dynamics (CFD) based investigation on the aerodynamic drag reduction techniques. The computational investigate of the situation is offered in a three-dimensional perspective of the automobile. The specific situation of vehicle design is studied in accordance with the changes made to some components of the design like splitters located at the front of the vehicle, designs of the vehicle bottom, diffuser of the vehicle back part and spoilers added to each vehicle. The effect of all the mentioned design changes is evaluated in isolation and also in combination with each other too. Changes in lift or downforce can also be analyzed since a decrease in drag should not lead to lowering the stability of the automobile at great speed. The research results obtained in this paper reveal the methodology of using CFD in the design solutions evaluation process.

Keywords: Car Aerodynamics; Computational Fluid Dynamics; Spoiler; Solidworks; Ansys; Velocity; Pressure.

ICEMSET-2026/ST/1279

Numerical and Experimental Investigation of the Wing Aerodynamic Performance of Modified Trailing Edge Configurations for UAV

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Abstract

This paper presents a numerical and experimental investigation of the aerodynamic and aeroacoustic performance of a tapered UAV wing with baseline and serrated trailing edges. The wing features a NACA 2412 airfoil, a root chord of 140 mm, a tip chord of 100 mm, and a span of 400 mm. The study examines the influence of trailing-edge serrations at low Reynolds numbers. Numerical analysis employs the Reynolds-Averaged Navier–Stokes (RANS) equations with the SST k–ω turbulence model, while aeroacoustic predictions are planned using the Ffowcs Williams–Hawkings (FW-H) analogy. Experimental testing is planned using a wind tunnel, six-component force balance, and microphone array. Although baseline CFD monitoring results are available, serrated-wing CFD and experimental data remain unavailable. Therefore, the serrated-wing results presented are indicative estimates and not validated simulation or experimental findings.

Keywords: NACA 2412; Trailing-Edge Serrations; UAV; Aerodynamics; Aeroacoustics.

ICEMSET-2026/ST/1280

Stall Performance of Smooth and Ribleted NACA 0018 Airfoils

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Abstract

This study compares steady, two-dimensional CFD predictions for smooth and suction-side ribleted NACA 0018 airfoils over angles of attack from 0° to 22°. Triangular riblets with normalized height and width of 0.005 cover the suction surface from 30% to 70% chord. Simulations used ANSYS Fluent with the SST k–ω model, a 15 m/s inlet, a 0.20 m chord, and air properties giving $Re_c \approx 2.05 \times 10^5$. The smooth airfoil produced the larger sampled peak lift coefficient, $C_L = 1.012$ at 14°, while the ribleted airfoil peaked at $C_L = 0.909$ at 16°. At 20° and 22°, the ribleted case had higher lift and lower drag. The 2° sweep identifies sampled maxima, not exact physical stall onset. These results indicate improved high-angle lift retention for the ribleted case within the simulated conditions.

Keywords: NACA 0018 airfoil; triangular riblets; stall; computational fluid dynamics; aerodynamic performance.

ICEMSET-2026/ST/1281

Coupled Inverse Kármán–Trefftz Airfoil Design for a Finite Wing

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Abstract

This work develops a coupled inverse-design method for selecting a Kármán–Trefftz airfoil camber to meet a lift coefficient for a rectangular wing. MATLAB couples conformal mapping with Prandtl lifting-line theory and uses optimization of the generating circle's vertical offset μy while solving the circulation distribution. For a wing with chord 0.050 m, span 0.200 m, aspect ratio 4, and 9° incidence, the optimized μy = 0.161516 achieves CL = 0.5500 with residual 3.25×10^{-9}. Lifting-line theory predicts CDi = 0.026471 and span efficiency e = 0.9094. Maximum camber and thickness are 7.42% and 11.83%, respectively. An archived ANSYS Fluent case reports CL = 0.54 and total CD = 0.11918 after 1000 iterations; however, its airfoil coordinates differ from the optimized geometry, so this result is a nominal comparison rather than direct validation. The framework exports 199 Selig-format coordinates and supports CFD and experimental assessment.

Keywords: Kármán–Trefftz airfoil; inverse design; lifting-line theory; low Reynolds number; finite-wing aerodynamics.

ICEMSET-2026/ST/1282

Computational Analysis of an Adaptive Winglet for Commercial Aircraft in Cruise Condition

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Abstract

This paper presents a computational fluid dynamics (CFD) assessment of a NACA 2412 wing fitted with a winglet positioned at a 20° cant angle. The model represents one side of a wing, with a span of 600 mm, a root chord of 300 mm and a tip chord of 150 mm. The winglet uses the NACA 2412 section and has constant 150 mm root and tip chords; its vertical height was not specified independently and results from the cant-angle positioning in the CAD model. The external-flow case was set up in ANSYS Fluent 2024 R2 using air at an inlet velocity of 30 m/s, an angle of attack of 0°, and an ambient pressure of 1 atm. A pressure outlet and no-slip wall conditions were applied. A steady pressure-based solver with the k-ω SST turbulence model and Coupled pressure-velocity scheme was used. The tetrahedral mesh contained 636,324 nodes and 3,681,868 elements, with no inflation layers. A 300-iteration calculation was specified. The available lift- and drag-monitor plots show non-physical magnitudes for dimensionless coefficients; therefore, the paper reports these traces qualitatively and does not claim final C_L, C_D or L/D values.

Keywords: Adaptive winglet; cant angle; NACA 2412; computational fluid dynamics; ANSYS Fluent; k-ω SST; tetrahedral mesh.

ICEMSET-2026/ST/1283

Structural and Spectroscopic Investigations of Co-Substituted Sodium Niobate Antiferroelectric Ceramics

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Abstract

Antiferroelectric perovskite have attracted considerable attention due to their promising high energy storage potential and unique field induced phase transition. In the present work, calcium(Ca) and tungsten(W) co-

substituted sodium niobate ceramics prepared by solid-state reaction technique. A comparative study of the pristine (x=0) and highly substituted (x=0.8) compositions constant W concentration was performed to examine the effect of compositional modification on their structural, vibrational and microstructural properties. X-ray diffraction (XRD), Raman spectroscopy, Fourier-transform infrared spectroscopy (FTIR) and Scanning electron microscopy (SEM) were used to characterize the synthesized ceramics. XRD analysis revealed systematic variations of diffraction features with increasing Ca content, indicating changes in the crystal structure. FTIR spectra showed characteristic metal-oxygen vibrational bands, suggesting changes in the local bonding environment. The Raman analysis also confirmed variations in the lattice vibrational modes due to Ca/W substitution. The average grain size decreased from 0.731µm (x=0.0) to 0.558µm (x=0.8) as observed by SEM, indicating microstructural refinement.

Keywords: Antiferroelectric ceramics, lead-free $NaNbO_3$, Retieveld Analysis.

ICEMSET-2026/ST/1284

Evaluation of Skin-Friction and Drag Characteristics of Blended Wing Body and Conventional AirCraft

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Abstract

The blended wing body (BWB) is routinely credited with a fifteen to twenty per cent improvement in cruise lift-to-drag ratio relative to a tube-and-wing (TNW) transport of equal payload and range, and that improvement is almost always attributed in the literature to reduced wetted area and reduced skin-friction drag. The attribution is rarely examined in quantitative detail, because the quantities that appear in published drag tables, namely the zero-lift drag coefficient and the friction coefficient, are normalised by a reference area that differs by a factor of more than two between the two configurations. This paper separates the three mechanisms that jointly produce the reported drag reduction: the level of the skin-friction coefficient itself, the wetted-to-reference-area ratio, and the mean form factor. Two notional 225-passenger, 5,000 nautical mile transports are defined on identical top-level requirements and analysed with a component drag build-up in which the compressible turbulent friction coefficient is obtained from the reference-temperature method applied to the Prandtl-Schlichting relation, with laminar extent, surface roughness, induced drag, wave drag and boundary-layer ingestion treated as explicit parameters. The BWB carries 30.3 per cent less wetted area and returns 24.7 per cent more lift-to-drag ratio at the design cruise point. Its zero-lift drag coefficient is 54 per cent lower, but only 18.5 per cent of that reduction survives when the comparison is made on drag area, and the wetted-area-weighted friction coefficient is in fact 6.3 per cent higher than that of the tube-and-wing, because the conventional fuselage is a body of very high fineness ratio operating at a Reynolds number more than five times larger than any surface on the BWB. The entire benefit therefore resides in wetted area per unit of useful volume and in span, not in the friction coefficient. Consequences for design effort, for laminar flow technology, and for the way BWB drag claims should be reported are discussed.

Keywords: Blended wing body; skin-friction coefficient; wetted area; drag decomposition; transonic cruise; laminar flow control.

ICEMSET-2026/ST/1285

Parametric Design and Aerodynamic Performance Evaluation of a Blended Wing Body Aircraft

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Abstract

Blended wing body (BWB) configurations integrate the lifting body and wing into a continuous aerodynamic planform, offering a potential route to lower wetted-area-related drag and improved lift distribution compared

with conventional tube-and-wing layouts. This paper presents a reproducible conceptual workflow for parametric CAD development and computational-fluid-dynamics (CFD) assessment of a subsonic BWB demonstrator. The geometry is defined in CATIA using a centre-body profile, swept outer panels, smooth spanwise lofts, and a controlled set of planform parameters. A proposed OpenFOAM workflow is described for external-flow simulation, including domain sizing, boundary conditions, mesh refinement, turbulence modelling, convergence checks, and force- coefficient extraction. To demonstrate the intended analysis and reporting method, the results section includes a small, clearly labelled illustrative dataset. These values are synthetic examples created to show how trends should be interpreted; they are not outputs from a completed OpenFOAM simulation and must not be cited as measured or validated performance. In the illustrative dataset, lift coefficient increases with angle of attack over the attached-flow range, while drag coefficient rises more rapidly at higher incidence. The example highlights the need to compare lift-to-drag ratio, pressure distribution, and separation patterns together rather than selecting a design from lift alone. The paper concludes with a practical validation plan and identifies mesh independence and reference-data comparison as prerequisites before making quantitative performance claims.

Keywords: Blended wing body; parametric CAD; CATIA; OpenFOAM; computational fluid dynamics; lift coefficient; drag coefficient; turbulence modelling; mesh independence.

ICEMSET-2026/ST/1286

CFD-Based Aerodynamic and Aeroacoustic Optimization of an Owl-Inspired Hybrid Serrated Aircraft Wing

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Abstract

The silent flight of owls has long inspired the design of low-noise aerodynamic surfaces. An owl wing combines leading-edge serrations, trailing-edge fringes and a soft velvety coating, which together suppress aerodynamic noise without a large loss of lift. In this work, a three-dimensional owl-inspired hybrid serrated wing is studied using computational fluid dynamics (CFD) coupled with an acoustic analogy. Three configurations are compared: a smooth baseline wing, a wing with conventional single-scale wavy trailing-edge serrations, and a hybrid wing that combines macro-scale trailing-edge waviness with micro-scale fringe elements and leading-edge serrations. The unsteady flow is resolved with large-eddy simulation (LES) on a high-resolution grid at a chord Reynolds number of 4.0×10^5, and the far-field noise is computed by solving the Ffowcs Williams–Hawkings (FW-H) equation. The aerodynamic coefficients are obtained from the time-averaged pressure and wall shear-stress fields. The hybrid configuration reduces the overall sound pressure level (OASPL) by up to 14.4 dB at 15° and by about 11.7 dB at 9° relative to the baseline, while the conventional wavy serration achieves about 11.1 dB and 8.9 dB respectively. The aerodynamic efficiency is preserved: the lift-to-drag ratio of the hybrid wing is within about 2% of the baseline up to 9° and improves at higher angles where separation is delayed. A parametric study shows that the noise reduction is maximised at a serration amplitude of $h/c \approx 0.15$ and a wavelength of $\lambda/c \approx 0.20$. The flow field shows that the dual-scale serrations break the trailing-edge vortices into smaller structures and reduce the spanwise coherence of the pressure fluctuations, which is the main mechanism of noise suppression. The results confirm that the owl-inspired hybrid serration is an effective passive device for the simultaneous improvement of aerodynamic and aeroacoustic performance.

Keywords: Owl-inspired aerodynamics; Bio-inspired wing; Leading-edge serrations; Trailing-edge serrations; Hybrid serration; Computational fluid dynamics (CFD); Large-eddy simulation (LES); Ffowcs Williams–Hawkings acoustic analogy; Aeroacoustic noise reduction; Passive flow control.

ICEMSET-2026/ST/1287

Synthesis and characterization of $(La_{1-x}Dy_x)_2CoFeO_6$ (x = 0.00, 0.05, 0.10) double perovskite oxides

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Abstract

$A_2BB'O_6$ double perovskite oxides are highly adaptable functional materials whose magnetic, electrical, optical, and catalytic properties can be engineered by varying the concentration of the *A*-site and/or *B*-site cations, making them a desirable option for energy conversion, spintronics, and sensing applications. The solid-state reaction was used to synthesize $(La_{1-x}Dy_x)_2CoFeO_6$ (x=0.00, 0.05, and 0.10), a DPO, from the $A_2BB'O_6$ family. X-ray diffraction was used to investigate the DPOs' phase purity and crystal structure. The diffractogram peaks have been identified, indexed, and mapped using the ICDD 00-053-1211 card. The positions of diffraction peaks tended to shift toward higher 2θ as Dy substitution increased, which could be explained by the incorporation of Dy^{3+} ions with small ionic radii to replace the larger ionic radii La^{3+} ion on the *A*-site. EDAX, FEG-SEM, and HR-TEM were used to study elemental distributions, surface morphology, and electron diffraction patterns of DPOs, respectively. According to the study, *A*-site-substituted Dy modifies microstructural characteristics without altering the perovskite structure. The implications are discussed.

Keywords: Double perovskite oxides; La_2CoFeO_6; *A*-site substitution; Solid-state reaction; Structural characterization.

ICEMSET-2026/ST/1288

Numerical Investigation of a Bio-Inspired Dragonfly Corrugated Wing for Enhanced Aerodynamic Performance of UAVs

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Abstract

Dragonfly wings possess naturally corrugated structures that influence aerodynamic characteristics, including vortex formation, pressure distribution, and flow separation at low Reynolds numbers. This study presents the design and numerical investigation of bio-inspired dragonfly corrugated wings for potential applications in unmanned aerial vehicles (UAVs). Two distinct corrugated wing configurations were developed using CATIA V5 by varying selected geometric parameters while maintaining identical chord and span dimensions. Computational Fluid Dynamics (CFD) simulations were performed using SimScale under identical flow conditions at a zero-degree angle of attack to investigate their aerodynamic behaviour. The numerical analysis focused on evaluating the lift coefficient, drag coefficient and flow-field characteristics of both configurations. The simulation results demonstrated i in aerodynamic coefficients, followed by gradual stabilization as the flow developed. Differences in drag characteristics were observed between the two models, indicating that variations in corrugation geometry influence aerodynamic resistance. The investigation provides a comparative understanding of the aerodynamic behaviour of bio-inspired corrugated wing configurations and establishes a foundation for further research into their potential application in small UAVs operating under low-Reynolds-number conditions.

Keywords: Bio-inspired wing, dragonfly wing, corrugated aerofoil, UAV, low Reynolds numbers, pressure distribution, CAD, CFD, aerodynamic performance.

ICEMSET-2026/ST/1289

Design and Analysis of Morphed rear wing spoiler

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Abstract
Aerodynamic forces shape car performance keep it stable and help it turn. Aerodynamic forces bring drag which makes the engine use power at high speeds and lift which takes some type contact off the road. Aerodynamic forces allow a rear wing to push the car down for grip but that rear wing stays fixed. This project is, about designing, analyzing and proving a rear wing that can change shape for a sports car. The new rear wing has a main part and a bendy trailing edge. An ESP32 board and a servo motor will move the wing when the speed is simulated. The wing geometry is designed using CAD software and analysed using ANSYS Fluent. Various wing settings are evaluated in terms of drag, downforce, pressure distribution, and airflow. In addition, a prototype will be constructed to demonstrate the automatic morphing of the rear wing.

Keywords: Adaptive rear wing; morphing structure; sports car, downforce; drag; CFD; ANSYS, Fluent; ESP32.

ICEMSET-2026/ST/1290

A Computational Study on the Effect of Wing Sweep Angle on Aerodynamic Performance of a Commercial Transport Aircraft Wing Across Subsonic Speed Regimes

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Abstract
Wing sweep is extensively used to mitigate the influence of compressibility at transonic speeds. Wing sweep can affect aerodynamics of aircraft flying at subsonic speed where compressibility is not a significant factor anymore; instead, spanwise flow at transonic speeds comes into play. This paper compares swept and non-swept wings with same airfoil section and aspect ratio flying at Mach 0.3 and Mach 0.5. Three-dimensional steady-state RANS computations with SST k-ω turbulence model are carried out to compare aerodynamic performance in terms of lift, drag, and pressure distribution. It was shown that the maximum lift coefficient of swept wings is slightly lower; also, induced drag is higher due to the presence of spanwise flow. Therefore, non-swept wings have better lift-to-drag ratio at subsonic speeds. Swept wings, however, show gradual stall behavior and less sensitive to AOA changes near stall, which leads to better handling qualities of an aircraft.

Keywords: Sweptback wing, subsonic aerodynamics, computational fluid dynamics, induced drag, stall progression, RANS simulation.

ICEMSET-2026/ST/1291

Numerical Investigation of a Bio-Inspired Dragonfly Corrugated Wing for Enhanced Aerodynamic Performance of UAVs

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Abstract
This study focuses on the design and numerical investigation of bio-inspired dragonfly wing corrugations to enhance the aerodynamic performance of Unmanned Aerial Vehicles (UAVs). Inspired by the natural wing structure of dragonflies, two corrugated wing configurations are developed using CAD modelling. The aerodynamic behaviour of both designs is investigated using computational fluid dynamics (CFD) simulations.

The study aims to evaluate important aerodynamic parameters, including lift coefficient (CL), drag coefficient (CD), and lift-to-drag ratio (L/D), under specified flow conditions. A comparative analysis of the two configurations is performed to understand the influence of wing corrugation on aerodynamic efficiency. The investigation aims to identify a suitable wing configuration that can contribute to improved aerodynamic performance and support the development of efficient bio-inspired UAV wings.

Keywords: Bio-inspired wings; Dragonfly wing; Corrugation; Computational Fluid Dynamics; Aerodynamic Performance.

ICEMSET-2026/ST/1292

CFD-Based Analysis of NACA 2412 Airfoil Performance at Different Angles of Attack

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Abstract

This paper investigates the aerodynamic performance of a NACA 2412 airfoil at different angles of attack using Computational Fluid Dynamics (CFD) in OpenFOAM. The analysis is conducted at a Reynolds number of (2.5 \times 10^5) and a Mach number of 0.20, covering angles of attack from 0° to 15°. The computational mesh is generated using Gmsh and imported into OpenFOAM for numerical simulation. Aerodynamic characteristics, including lift coefficient ((C_L)), drag coefficient ((C_D)), pitching-moment coefficient ((C_M)), and lift-to-drag ratio, are evaluated. The results indicate that lift increases with angle of attack, reaching 1.3262 at 12°, accompanied by an increase in drag. At 15°, strong oscillations in the force history indicate unsteady flow behaviour or insufficient convergence. The findings demonstrate the influence of angle of attack on airfoil aerodynamic performance and highlight the importance of mesh independence, convergence analysis, and experimental validation for reliable CFD predictions.

Keywords: NACA 2412; computational fluid dynamics; angle of attack; OpenFOAM; Gmsh; lift coefficient; drag coefficient; pressure coefficient; flow separation.

ICEMSET-2026/ST/1293

Quantum Key Distribution-Enabled Semantic Communication Framework with AI-Based Authentication and Intelligent Beamforming for Secure 6G Wireless Networks

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Abstract

The rapid revolution of 6G support highly intelligent, high data rate as today needs of more data network but same time face challenges like security and privacy issue so, existing techniques may face challenges due to more dynamic environment and complexity and hacking issue .so, overcome these challenges quantum technology is efficient technology to provide security. This work proposed a Quantum Key Distribution-Enabled Semantic Communication Framework with AI-Based Authentication and Intelligent Beamforming for Secure 6G Wireless Networks. This Proposed work implemented Quantum Key distribution integrates BB84 based QKD for secure key , AI(artificial intelligent for reliable user authentication semantic communication for task oriented efficient transmission of data & efficient channel utilization .In this framework quantum key distribution generates a secure secret key and evaluate bit error rate .The AI tool framework implemented neural network classifier to distinct authenticate user from malicious user .The semantic communication module emphasizes source code by using reducing redundant information and intelligent beamforming increases received signal strength .The Proposed system improves reliability ,authentication , security , privacy and increased spectral efficiency .The work is evaluated through MATLAB simulation and performed and analysed in terms of bit error rate (BER), authentication accuracy, false acceptance rate (FAR), false rejection rate (FRR), QBER, semantic similarity, and secrecy rate under various signal to noise ratio.

ICEMSET-2026/ST/1294

Experimental and Computational Analysis of Wing Vortex Reduction by Incorporating Circular Wingtip Holes on a NACA 2412 Wing

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Abstract

This study presents the CAD design and a computational fluid dynamics (CFD) investigation of a NACA 2412 finite wing incorporating circular holes near the wingtip. Wingtip vortices form because of the pressure difference across a finite lifting surface and are associated with downwash and induced drag. The modified wing was designed with nine circular holes of 2 mm diameter and 10 mm spacing. The wing has a chord of 140 mm and a span of 400 mm, and the reported CFD operating condition is a freestream velocity of 30 m/s at 0° angle of attack. A three-dimensional flow simulation was carried out in ANSYS Fluent, and the available post-processing includes static-pressure contours, velocity-magnitude pathlines, static-pressure pathlines, and a force report for the modified configuration. These results describe the computed flow field for the single simulated design. The solid-wing baseline was designed but was not simulated, and wind-tunnel testing was proposed but not performed. Consequently, the present results do not establish a comparative reduction in wingtip-vortex strength, nor do they quantify a percentage reduction relative to a baseline. The study documents the design and initial CFD assessment of the perforated wingtip and provides a basis for future baseline comparison, quantitative vortex-strength evaluation, and experimental validation.

Keywords: NACA 2412; Wingtip Vortex; Circular Wingtip Holes; Vortex Reduction; CFD; Wind Tunnel; Vorticity; Induced Drag.

ICEMSET-2026/ST/1295

Hydrothermal Synthesis and Characterization of CuO/ZnO/SnO Nanocomposite for Ammonia Gas Sensing at Room Temperature

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Abstract

Agriculture and environmental applications, monitoring of dangerous ammonia (NH_3) emissions ✂is needed by the development of sensitive and energy-efficient gas sensors working at room-temperature. The aim of the present work was to synthesize and investigate the ternary nanocomposite CuO-ZnO-SnO for room-temperature ammonia gas sensing by employing hydrothermal synthesis. Resulting synthesized materials were characterized through x-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive x-ray spectroscopy (EDX) and fourier transform infrared spectroscopy (FTIR) to examine their structural, morphological, elemental, and chemical properties. The results showed the presence of CuO, ZnO and SnO phases having nanoscale crystallite size. Gas-sensing measurement results showed that a concentration dependent response was obtained for NH3; a response of 13.7% at 5 ppm and 53.7% at 200 ppm were obtained. The sensor's response at 100 ppm NH✂ was 46.1% with a response time of about 35 s. The sensor also had high selectivity, repeatability and stability, suggesting that it has the potential for practical room-temperature ammonia detection.

Keywords: CuO/ZnO/SnO, Nanocomposite, Hydrothermal synthesis, Ammonia sensing, Gas sensor, Room temperature.

ICEMSET-2026/ST/1296

Comparative Analysis of Random Forest and Support Vector Machine Using EfficientNet-B0 Deep Features for Knee Osteoarthritis Severity Classification from X-Ray Images

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Abstract

Knee osteoarthritis (KOA) is a progressive musculoskeletal disorder in which the severity of joint degeneration is commonly assessed from radiographic findings using the five-level Kellgren–Lawrence (KL) grading system. Automated classification of KOA severity from X-ray images can assist in standardised assessment; however, five-class classification remains challenging because of class imbalance and visual similarity between neighbouring severity grades. This study presents a comparative analysis of Random Forest (RF) and Support Vector Machine (SVM) classifiers using deep features extracted from a pretrained EfficientNet-B0 network for five-class KOA severity classification. A publicly available knee X-ray dataset containing KL grades 0–4 was used for the experimental evaluation. EfficientNet-B0 was employed as a fixed feature extractor to generate 1280-dimensional deep feature representations from the X-ray images. The extracted features were subsequently classified independently using class-weighted RF and SVM models. Stratified five-fold cross-validation and macro-F1-based hyperparameter tuning were performed to account for the substantial class imbalance in the dataset. The optimised RF model achieved a test accuracy of 48.79% and a macro-F1-score of 0.2928, whereas the SVM achieved a test accuracy of 49.76% and a macro-F1-score of 0.4716. The SVM also produced non-zero F1-scores across all five KL grades, with comparatively better performance for the moderate and severe categories. In contrast, RF demonstrated substantially lower inference time, indicating a trade-off between class-balanced predictive performance and computational efficiency. The experimental findings provide a comparative baseline for deep-feature-based KOA severity classification and highlight the challenges associated with fine-grained five-class radiographic grading.

Keywords: Knee osteoarthritis, Kellgren–Lawrence grading, X-ray classification, EfficientNet-B0, deep feature extraction, Random Forest, Support Vector Machine, class imbalance, severity classification.

ICEMSET-2026/ST/1297

Molybdenum-Engineered $ZnFe_{2-x}Mo_xO_4$ Nanoarchitectures for High-Performance Supercapacitor Applications

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Abstract

Spinel zinc ferrite ($ZnFe_2O_4$) is an attractive electrode material owing to multivalent redox centers, natural abundance, and high theoretical capacitance[1]. In this work, molybdenum-substituted zinc ferrite nanoarchitectures, $ZnFe_{2-x}Mo_xO_4$ (pristine, 4%, and 8% Mo), were synthesized to systematically tune structural and electrochemical behaviour for supercapacitor electrodes[2,3]. XRD, FTIR, and BET surface-area analysis, performed across three compositions, confirmed single-phase cubic spinel lattice with progressive lattice contraction, characteristic metal–oxygen vibrational modes, and systematic rise in specific surface area upon Mo^{6+} incorporation. Raman spectroscopy and FESEM imaging of Mo-doped samples revealed doping-induced local lattice distortion and refined morphology, while HRTEM and XPS of 8% sample confirmed well-resolved lattice fringes and coexistence of Mo^{6+}/Mo^{5+} alongside Fe^{2+}/Fe^{3+} and Zn^{2+} states, indicating additional accessible redox couples and improved charge-transfer pathways. Electrochemical investigation across all three compositions showed that Mo doping systematically enhances redox reversibility[4] and lowers charge-transfer resistance relative to the pristine ferrite (Fig. 1).

Keywords: Zinc ferrite; Molybdenum doping; Spinel nanostructure; Pseudo capacitor; Redox kinetics.

ICEMSET-2026/ST/1298

An AI-Based Impact Monitoring and Decision Intelligence Platform for Automated Multi-Format Document Processing and Analytics

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Abstract

Organizations engaged in development, corporate social responsibility (CSR), and public-sector programme delivery routinely accumulate impact and funding records across heterogeneous formats — scanned field reports, PDF proposals, DOCX meeting minutes, and Excel/CSV funding sheets — typically consolidated by hand, a slow, inconsistent, error-prone process. This paper presents an AI-Based Impact Monitoring and Decision Intelligence Platform automating the full pipeline from document ingestion to decision-ready analytics. The system combines format-aware ingestion with OCR fallback for scanned content [1]–[5], rule-based data cleaning covering missing-value imputation, duplicate removal, and interquartile-range (IQR) outlier flagging [6]–[11], an unsupervised TF-IDF-weighted TextRank summarizer for narrative reports [12]–[15], and a decision-intelligence layer producing department-wise activity, geographic distribution, funding trends, and a least-squares funding forecast. The platform was implemented in Python and validated on a five-document, multi-format synthetic corpus (PDF, DOCX, XLSX, CSV, and a scanned image) exercising every pipeline stage under controlled, reproducible conditions. In this single run, the system processed all five documents in 1.03 seconds end-to-end, recovered all 42 ground-truth words in the scanned-image case (100% word-level accuracy), and — across the two tabular datasets — removed six seeded duplicate rows, imputed missing values in six columns, and flagged two outlier-affected columns (each dataset contributing half these totals; see Section 5). Extractive summaries achieved an average compression ratio of 0.49 (output-to-input sentence count). These results demonstrate the technical feasibility of the proposed architecture as a foundation for automated, auditable impact-monitoring pipelines; the paper reports the limitations of small-scale validation and the real-world piloting required before deployment.

Keywords: Document Intelligence; Optical Character Recognition; Data Cleaning Automation; Extractive Summarization; Impact Monitoring.

ICEMSET-2026/ST/1299

Structural and magnetic properties of Gd^{3+} substituted nanocrystalline cobalt ferrite

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Abstract

In this study, we have investigated the impact of Gd3+ substitution on the structural and magnetic properties of the spinel cobalt ferrite CoFe2-xGdxO4 (x=0.05, 0.10, 0.15, and 0.20) which was synthesized by using the citrate precursor sol-gel technique and then control annealed at 750 °C. The gross-structural characteristics of the nanoparticles confirmed spinel crystal symmetry with the space group Fd3m. The Williamson-Hall (W-H) plot shows maximum value of lattice strain 2.71×10-3 for CoFe1.85Gd0.15O4. The lattice parameter (a) shows a discernible increase as a result of induced strains. The lengths of the tetrahedral and octahedral M-O bonds are determined by the FTIR. The "Law of Approach to Saturation" quantifies that with an increase in Gd3+ concentration, saturation magnetization (Ms), Coercivity (Hc) and magneto-anisotropy (k1) decreases from 73.16 to 49.89 emu/g, 1452 to 989 Gauss and 9.22 to 3.22×106 erg/cm3, respectively. We have investigated a relationship between induced lattice strain and magnetic response for CoFe2-xGdxO4 with Gd=0.05 to 0.20. The very high coercivity of 1441 Gauss suggests employing such materials for the permanent magnet and high-density magnetic recording medium.

Keywords: pinel ferrite; Coercivity, Lattice Strain, Anisotropy, Ferrimagnetic, Magnetization.

ICEMSET-2026/ST/1300

Comparative Investigation of Microstructural, Phase and Mechanical Characteristics of Similar and Dissimilar Friction Stir Welded AA6082 and AA7075 Aluminium Alloys

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Abstract
Similar and dissimilar friction stir welded AA6082 and AA7075 aluminium alloy joints were investigated to evaluate their mechanical, microstructural and phase characteristics. Welding was performed using a tapered-pin tool at 1200 rpm and 40 mm/min. Four configurations were examined: AA6082–AA6082, AA7075–AA7075, AA7075 (AS)–AA6082 (RS), and AA6082 (AS)–AA7075 (RS). Tensile testing revealed maximum stresses of approximately 111 MPa, 241 MPa and 175 MPa for AA6082, AA7075 and dissimilar joints, respectively. SEM fractography revealed dimple-like features associated with ductile fracture. EDS analysis identified variations in elemental composition within the stir zones. XRD confirmed the predominant FCC aluminium matrix, alongside secondary intermetallic phases, including Mg_2Si, $MgZn_2$, Al_2CuMg and Al_7Cu_2Fe. The findings demonstrate that base alloy composition and material arrangement significantly influence phase characteristics and tensile behaviour, providing insights into the metallurgical performance of similar and dissimilar friction stir welded aluminium joints.

Keywords: Friction stir welding; AA6082–AA7075 aluminium alloys; Microstructural characterization; Phase analysis.

ICEMSET-2026/ST/1301

Higher Order Elastic Constants and Ultrasonic Attenuation of platinum group metal nitrides

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Abstract
In this study, the elastic and mechanical stability of platinum-group metals nitrides (PGMNs), denoted as XN (where X = Ru, Rh, Pd), was systematically evaluated within a temperature range of 0–500 K using the Born model. Second- and third-order elastic constants (SOECs and TOECs) were used to determine the values of mechanical parameters, ultrasonic velocities, Debye velocity, thermophysical parameters, and ultrasonic attenuation along the ⟨100⟩, ⟨110⟩, and ⟨111⟩ crystallographic axes. The evaluated mechanical properties indicate that RuN, RhN, and PdN are brittle in nature at room temperature. The Debye mean velocity and Debye temperature were found to be highest along the ⟨100⟩ direction. The relaxation time is found to be on the order of that observed in metals. Ultrasonic attenuation is primarily determined by the Akhiezer process. Theoretically derived values were compared with those of similar materials possessing a B1-structure, and the performance of the nitrides of ruthenium, rhodium, and palladium was evaluated based on the parameters obtained.

Keywords: Platinum group metals nitrides, elastic constants, mechanical properties, Grüneisen parameter.

ICEMSET-2026/ST/1302

AI-Based Quality Disturbance Detection and Classification using IOT, MQTT and Cloud Analytics

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Abstract
Power quality disturbances (PQDs) such as voltage sag, voltage swell, interruption, and harmonic distortion can affect the reliability and performance of electrical equipment. This paper proposes an AI-based quality

disturbance detection and classification framework integrating IoT, MQTT, and cloud analytics for real-time power quality monitoring. The system uses ZMPT101B and SCT-013 sensors with the ATM90E32 power measurement IC to acquire electrical parameters. An ESP32 microcontroller performs data acquisition, preprocessing, and communication through Wi-Fi. A Random Forest (RF) classifier is used to classify power quality conditions into five categories: normal, voltage sag, voltage swell, interruption, and harmonic distortion. The classified results and measurements are transmitted to a cloud platform using MQTT, enabling remote monitoring, data storage, visualization, and event-based alerts. The proposed system aims to overcome the limitations of conventional threshold-based and offline approaches by providing real-time edge-to-cloud monitoring. Performance is evaluated using accuracy, precision, recall, F1-score, and confusion matrix.

Keywords: Power Quality Disturbances, Internet of Things, Random Forest, ESP32, ATM90E32, MQTT, Cloud Analytics, Voltage Sag, Voltage Swell, Harmonic Distortion.

ICEMSET-2026/ST/1303

Hydrothermal Synthesis of a Bio-Derived Zinc (II) Coordination Polymer: Characterization and Antibacterial activity

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Abstract

A zinc (II) carboxylate coordination polymer (Zn (II)-CCP) was synthesized through a sustainable bio-assisted hydrothermal approach using a saturated solution of a zinc (II) precursor complex, [$C_{32}H_{62}O_4Zn$], derived from *Boehmeria virgata* leaf extract. The hydrothermal treatment facilitated the formation of an extended zinc-carboxylate coordination network, demonstrating an effective strategy for developing plant-derived metal-organic materials. The composition, coordination environment, structural features, and physicochemical properties of the synthesized material were investigated using analytical and spectroscopic techniques, including FTIR, UV-Vis spectroscopy, mass spectrometry, single-crystal X-ray diffraction (SC-XRD) and powder X-ray diffraction (PXRD). Single-crystal structural elucidation revealed an extended three-dimensional Zn-carboxylate coordination network featuring bridging carboxylate groups and distorted octahedral coordination geometry around the Zn (II) centres. The biological evaluation demonstrated promising antibacterial activity against tested bacteria.

Keywords: Zn (II) carboxylate coordination polymer; Green synthesis; Structural elucidation; SC-XRD study; Antimicrobial Activity.

ICEMSET-2026/ST/1304

Battery State-of-Health Estimation Using Physics-Based Degradation and Residual Learning

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Abstract

The performance of lithium-ion batteries is affected by its gradual capacity decrease in the repeated charge and discharge process. Accurate State-of-Health (SOH) estimation is important to keep track of such degradation. This work proposes a hybrid physics-based approach that consists of a fixed degradation model with a small neural network residual. To make a prediction, the model looks at 3 critical battery features, these include the number of cycles completed, total ampere-hours throughput and the average temperature of the battery. The model is developed and evaluated on the Oxford Battery Degradation Dataset that includes cycle-level data of eight Kokam pouch cells. It shows a mean absolute error (MAE) 0.0167 with an R^2 score of 0.9168 in a randomly selected 80/20 test split, which is slightly better than the pure physics-based model (MAE 0.0188, R2 0.8928). The system can also predict the remaining useful life through an 80% SOH threshold and has a command-line and Flask interface for inference. The results show the potential of the proposed model to improve SOH prediction

Keywords: Lithium-ion batteries; State of Health (SOH); Physics-informed learning; Residual neural network; Remaining useful life (RUL).

ICEMSET-2026/ST/1305

Merging Specialists: Conciseness and Error-Detection

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Abstract

This paper aims to check whether two specialists, namely Error-Detection specialist and conciseness specialist, fine-tuned from the same base model can merge and maintain their skills, without retraining. I performed the experiment on Gemma-3 1B and Qwen2.5 1.5B and merged the specialists using linear, SLERP, TIES, DARE-TIES and task arithmetic. In Gemma, DARE-TIES correctly indicated root error 32.6% of the time, as compared to the fine-tuned error detection specialist which indicated 30.2% of the time. In Qwen, DARE-TIES indicated it 26.7% of the time, compared to 17.7%. DARE-TIES also had conciseness line F1 at around 99%. Linear and SLERP collapsed into conciseness and lost almost all root error detection skill. Thus, the proposed method can use sign-aware methods such as TIES and DARE-TIES to merge fine-tuned models while maintaining skills without the need to retrain.

Keywords: Model merging; LoRA fine-tuning; DARE-TIES; Error detection; Conciseness.

ICEMSET-2026/ST/1306

Survey of Plant-Parasitic Nematodes Associated with Kinnow Orchards of Haryana

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Abstract

Citrus belongs to the family Rutaceae and is one of the most economically important fruit crops worldwide. Kinnow mandarin (*Citrus nobilis* × *Citrus deliciosa*) is a prominent cultivar widely recognized for its high yield and productivity. Citrus fruits are a rich source of vitamin C, calcium, phosphorus and iron. In Haryana, citrus is grown on 25,176.3 ha with 3,59,084 MT production. However, despite the high yield potential of Kinnow, its productivity is considerably affected by soil-borne pathogens, particularly plant-parasitic nematodes (PPNs), which cause substantial yield losses in Kinnow orchards. Major nematode genera associated with Kinnow include *Tylenchulus semipenetrans*, *Helicotylenchus* spp., *Hoplolaimus* spp., *Pratylenchus* spp., and *Rotylenchulus* spp. which collectively contribute to citrus decline. In India, *T. semipenetrans* causes 27% yield reductions with monetary losses of Rs. 9828 million in citrus crops. A field survey conducted during November, 2025 in Hisar and Fatehabad districts revealed substantial variability in nematode populations across locations. A total of 58 samples were collected and analyzed to assess the presence of nematodes. The results revealed that the highest absolute frequency among the nematodes was recorded for *T. semipenetrans* (72.41%), followed by *Helicotylenchus* spp. (70.68%), *Hoplolaimus* spp. (58.62%), *Pratylenchus* spp. (51.72%), and *Rotylenchulus* spp. (37.93%). Citrus nematode was detected in 75.00% and 70.59% samples of Fatehabad and Hisar districts, respectively.

Keywords: Plant-parasitic nematodes, *Tylenchulus semipenetrans*, *Helicotylenchus* spp., *Hoplolaimus* spp. and citrus decline.

ICEMSET-2026/ST/1307

Biomass-Derived Carbon-Enhanced MoS_2/ZnO Tetrapod Hybrids for High-Performance Asymmetric Supercapacitors

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Abstract

The increasing global energy demand and environmental challenges associated with agricultural waste disposal require sustainable, high-performance energy storage materials. Herein, a ternary hybrid electrode comprising MoS_2 nanoflowers, ZnO tetrapods (ZT), and wheat straw-derived activated carbon (AC) is rationally designed for asymmetric supercapacitors (ASCs). ZnO tetrapods synthesized via flame transport provide a robust three-dimensional scaffold, while hydrothermally grown MoS_2 nanoflowers supply abundant redox-active sites. The successful formation of the hybrid is confirmed by XRD, FTIR, FESEM, TEM, XPS, BET, and water contact angle analyses. Biomass-derived AC enhances electrical conductivity and provides a hierarchical porous network for rapid ion transport. The optimized MZT–AC electrode delivers a high specific capacitance of 663 F g^{-1} at 1 A g^{-1}, significantly outperforming the individual components. The assembled MZT–AC//AC asymmetric supercapacitor operates over a 1.5 V potential window, achieving a maximum energy density of 63.54 Wh kg^{-1} at a power density of 750 W kg^{-1} while maintaining excellent cycling stability over 5000 cycles. The device also successfully powers a commercial LED, demonstrating its practical applicability. This work presents a sustainable strategy for converting agricultural waste into value-added carbon for high-performance energy storage applications.

Keywords: Asymmetric supercapacitor, MoS_2 nanoflowers, ZnO tetrapods, Biomass-derived activated carbon, High energy density, Energy storage.

ICEMSET-2026/ST/1308

Bait Shield: A Multi-Vector Endpoint Framework for Detecting and Mitigating Social Engineering Attacks

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Abstract

Social engineering attacks exploit user trust and curiosity through deceptive URLs, misleading downloads, baited USB storage, and keystroke-injecting USB devices. This paper presents Bait Shield, a multi-vector endpoint framework for detecting and mitigating these threats. The system combines a Chrome Manifest V3 extension for URL and download monitoring, a Python desktop agent for USB and file monitoring, a Node.js telemetry backend, and a React dashboard. Weighted heuristics analyze URLs, downloaded files, and USB devices, assigning a common risk score from 0 to 100 across low, medium, and high severity levels. The framework can block high-risk URLs and deceptive downloads while detecting and reporting suspicious USB activity. Evaluation on 211 URLs reported 98.2% bait-URL detection at the warning threshold, with no false positives among 155 legitimate sites. The URL analyzer recorded a median processing time of 17.3 microseconds, and 221 automated checks assessed system behavior. Inspected files are never executed.

Keywords: Baiting attacks; Social engineering; USB security; Deceptive downloads; Endpoint protection.

ICEMSET-2026/ST/1309

Monocular Vision-Guided 2-DOF Robotic Manipulator for Precision Root-Targeted Micro-Irrigationand Agro-Chemical Delivery

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Abstract

Conventional agricultural broadcast spraying and mistblowingwasteupto85%ofappliedagro-chemicalsthrough atmosphericwind drift, inter-row soil runoff, and non-target foliar deposition. While robotic spot-sprayers reduce chemical volumes, existing platforms typically depend on expensive multi axis industrial arms and active infrared depth cameras that de grade under intense midday solar irradiance. This paper presents alow-cost, monocularvision-guided 2-DOFplanarmanipulator forprecisionroot-collarmicro-dosing. The systemtracks end effector pose using four circular color fiducials positioned at known Euclidean baselines (Dv=60mm, Dh=75mm) around amicro-jet nozzle. Pin hole triangle similarity over detected pixel baselines resolves 3D position and the 3D nozzle pointing vector without stereoscopic disparity matching. An analytical Law of Cosines inverse kinematics solver aligns the arm in an operational elbow-upconfiguration ($\theta1=+53.8^\circ$,$\theta2=-88.2^\circ$), maintaining ground clearance above the soil surface.

Keywords: Agriculturalrobotics, precisionmicro-irrigation, monocular pose estimation, visual servoing, inverse kinematics, spot spraying.

ICEMSET-2026/ST/1310

Investigation of Microstructural and Mechanical Characteristics of AA7075 Friction Stir Welds Produced Using Hard-V Coated H13 Tool

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Abstract

Friction Stir Welding (FSW) of high-strength aluminium alloys, particularly AA7075, requires tools capable of withstanding severe wear and elevated temperatures. This study investigates the effect of a chromium–carbon–manganese-rich Hard-V coating deposited on an H13 steel FSW tool by comparing joints fabricated using coated and uncoated tools. AA7075 plates were welded under identical processing parameters, followed by macrostructural and microstructural examinations, X-ray diffraction (XRD), microhardness measurements, tensile testing, fractography, and fatigue crack-growth rate (FCGR) evaluation. The coated tool promoted grain refinement in the stir zone and marginally increased microhardness across most weld regions. Nevertheless, XRD and fractographic observations identified coating-derived carbide and oxide inclusions within the weld metal. These particles acted as stress-concentration sites, adversely affecting tensile strength and fatigue resistance. In comparison, joints produced using the uncoated tool exhibited higher ultimate tensile strength (approximately 430 MPa), improved ductility, and extended fatigue life. The findings indicate that despite potential improvements in tool wear resistance, coating degradation and particle incorporation can compromise weld integrity, highlighting the importance of coating stability in FSW of precipitation-hardened aluminium alloys.

Keywords: Friction Stir Welding, AA7075, Hard-V coating.

ICEMSET-2026/ST/1311

Transformer Based Human Action Recognition and Correction for Physiotherapy

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Abstract

Physiotherapy exercises must be performed correctly for rehabilitation to be effective, but continuous supervision by a physiotherapist is not always available, particularly during home-based exercise. This work presents a Transformer-Based Human Action Recognition and Correction framework for Physiotherapy using RGB video and skeleton-based motion analysis. MediaPipe Pose Landmarker is used to extract 33 body landmarks from each video frame, which are mapped to an 18-joint COCO-compatible skeleton. To obtain a consistent temporal representation, each movement sequence is resampled to 64 frames. Joint position and frame-to-frame velocity features are then computed, resultying in a four-channel skeleton representation containing x, y, v_x, v_γ information. The extracted skeleton sequences are processed using an adapted

HyperFormer network that models spatial relationships among body joints and temporal dependencies across the complete movement sequence. The proposed framework can further be extended by analsyzing movements classified as Incorrect through exercise-specific error categories such as Error1, Error2, and Error3. These error predictions can then be associated with appropriate corrective feedback for the user. The overall approach demonstrates the potential of skeleton-based Transformer models for accessible physiotherapy exercise recognition, movement-quality assessment, and future automated corrective guidance using ordinary RGB video.

Keywords: Physiotherapy Exercise Assessment, Skeleton-Based Action Recognition, Human Pose Estimation, MediaPipe Pose, Skeleton Transformers, HyperFormer, Transfer Learning.

ICEMSET-2026/ST/1312

Real-Time Ar Pedestrian Navigation Using a Dual-Tier Database Architecture

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Abstract

This project is a two-tier database architecture for a real-time augmented-reality (AR) pedestrian navigation system with AR smart glasses. The system captures step count, heading, stride length and raw IMU (accelerometer/gyroscope) readings at high frequency during an active navigation session, writes them into a write-optimized "hot path" table, smooths the heading in real time using a SQL window function, and the instant a session ends automatically aggregates, summarizes, and purges the raw telemetry into a compact "cold path" historical table using a database trigger and stored procedure. GPS-based navigation does not have the positional accuracy that AR smart glasses require. Continuously storing the raw high-frequency sensor data from lots of simultaneous users creates unbounded write load, unbounded storage growth, and query slowdown if it is never separated from historical data. The dual-tier design tackles this problem directly by separating the live, high-write workload from the read-heavy analytical workload, so neither competes with the other for database resources.

Keywords: Steps, Latency, Smart, Navigation, GPS.

ICEMSET-2026/ST/1313

Docking, Molecular Dynamics and DFT of Phytochemical – Nanomaterial Interfaces in MASLD-Linked Hepatocellular Carcinoma

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Abstract

Metabolic dysfunction-associated steatotic liver disease (MASLD) can progress to steatohepatitis, fibrosis, and cirrhosis then on to hepatocellular carcinoma to create a complex biochemical environment for therapeutic discovery. This chapter presents the computational assessment of phytochemical interactions with modified nanomaterial surfaces for experimental research into liver cancer. Potential compounds are screened using pathway-based target identification, physicochemical analyses, and structure-based virtual screening. Molecular docking suggests active binding conformations while molecular dynamics simulations explore binding stability, hydration, near-residue interactions, and energetic trends. Density functional theory yields additional electronic descriptors such as frontier orbital profiles, distribution of charges, and aromaticity/acceptor properties. Surface termination and functionalization, particle shape, and solvent effects are noted as influential on absorption and desorption. Disease centered linking of candidates to oxidative stress, lipid metabolism, inflammation, and proliferation may be achieved with hepatic omics datasets; however, biologists must directly verify the associated molecular identities. Limitations include the broadness of force field modeling for nanostructures, protonation dependent calculations, limited conformational sampling, and unknown correlations between nanoscale binding and *in vivo* pharmacology. The experimental considerations include characterization of nanoparticles, solutions of adsorption isotherms and release kinetics, hepatocyte-based toxicity tests, and

targeting tumor relevant receptors. It will be important to evaluate the disease specificity of the models versus healthy controls and their interactions with other liver diseases. This outline describes a robust approach of linking computational and experimental techniques to investigate phytochemical nanomaterial efficacy hypotheses and emphasizes well documented, objectively validated, and highly relevant experimental data before claiming unproven therapeutic levels of evidence.

Keywords: MASLD-associated hepatocellular carcinoma; Phytochemicals; Density functional theory; Molecular dynamics; Virtual screening.

ICEMSET-2026/ST/1314

Deep Learning for Lung Cancer Lymph Node Metastasis Detection in Clinical Imaging: A Review

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Abstract

With lung cancer contributing to the worldwide problem of cancer-related deaths, lymph node metastasis (LNM) is an important component in terms of staging, prognostic factors and treatment planning for patients with lung cancer. Recent improvements in deep learning (DL) methods have greatly improved lymph node detection using CT, PET/CT and MRI imaging techniques. This article will review the development and current status of modern DL methods for detecting LNM, specifically: Convolutional Neural Networks (CNNs), Dense Net, transformer architectures, attention-based mechanisms, deformable operations and multi-loss learning techniques. Additionally, hybrid CNN-Transformer models allow the extraction of improved features from images by providing contextual information to help improve diagnosis accuracy. The development of DL systems still faces several obstacles, including limited numbers of annotated datasets, poor interpretability, and lack of clinical validation. Therefore, future research should work toward developing robust, explainable and clinically applicable multi-modal DL systems.

Keywords: Deep learning, hybrid CNN–transformer, lung cancer, lymph node metastasis.

ICEMSET-2026/ST/1315

Tailoring Triangular Zigzag Graphene Quantum Dots with –CN and –NO Groups for Enhanced Optoelectronic and Biomedical Performance

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Abstract

The ability of Graphene Quantum Dots (GQDs) to fulfil the demand of third-generation photovoltaic technology makes them a promising candidate. This computational study has been conducted to figure out the effect of functionalization with nitrogen-containing groups on the optoelectronic properties of GQDs. The calculations were performed for all QDs using the 6-311g (d) basis set and the PCM model using Gaussian 09 software. GaussView 5.0 has been utilised as a visualisation tool. Optoelectronic properties, including HOMO-LUMO gap, charge density difference (CDD), transition density matrix (TDM) and absorption spectra, are calculated. In order to analyse the electron excitation, absorption spectra data are used, which are extracted by Multiwfn software. HOMO-LUMO isosurfaces of all GQDs are also analysed, which represent σ-bond properties along with some π-bond characteristics in all GQDs. It has been analysed that in functionalised GQDs, the charge density shifts towards the functionalised group due to its electronegative nature. The UV absorption peak of pristine GQD $C_{13}H_9$ is found to be at 335.52 nm. Doping with nitrogen groups strongly influences the spectra; the absorption peak shifts to 364.95 nm due to the -C=N (cyano) group and to 345.86 nm due to the -N=O (nitroso) group. In -N=O-containing GQD, another sharp peak arises in the IR region at 959.92 nm, indicating its possible usage in the biomedical field. In the case of -C=N functionalised GQD, a sharp peak also arises at 273.76 nm with oscillator strength 0.22 in the UV region. Our findings indicate that the absorption spectra show

a red shift in the visible and NIR region, which allows them to be utilised in the biomedical field and in optoelectronic devices.

Keywords: Graphene Quantum Dots, Gaussian09, Optoelectronic devices.

ICEMSET-2026/ST/1316

An Adaptive Energy-Efficient Clustering and Routing Protocol for Heterogeneous Wireless Sensor Networks Using Hybrid Metaheuristic Optimization

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Abstract

Wireless Sensor Networks (WSNs) constitute the essential sensing layer of modern Internet of Things (IoT) ecosystems, supporting applications such as environmental surveillance, precision farming, and industrial process automation. The battery-operated nature of sensor nodes, however, restricts the operational lifetime of the network, especially in remote or large-scale deployments where periodic battery replacement is impractical. Heterogeneous Wireless Sensor Networks (HWSNs), in which nodes are provisioned with dissimilar energy reserves, can prolong network operation provided that energy-rich nodes are intelligently assigned to energy-intensive responsibilities such as Cluster Head (CH) duty. Conventional clustering schemes, nevertheless, depend on rigid probabilistic rules for CH election and optimize routing independently of clustering, which leads to uneven energy drainage and early node failures. To overcome these shortcomings, this work proposes the Hybrid Spotted Hyena-Firefly Clustering with Adaptive Routing (HSF-CAR) protocol for three-tier HWSNs. The protocol couples the wide global search ability of the Spotted Hyena Optimizer (SHO) with the precise local refinement capability of the Firefly Algorithm (FA) to perform dynamic CH selection. A multi-objective, round-adaptive fitness function unifies residual energy, Base Station distance, intra-cluster compactness, and node heterogeneity tier, with weights that evolve as the network state changes. In addition, an adaptive multi-hop inter-cluster routing procedure relieves distant CHs by choosing relay nodes through a heterogeneity-aware cost metric. The protocol will be assessed through extensive MATLAB simulation against LEACH, SEP, DEEC, E-SEP, SHO-CH, and PSO-ECSM using First Node Dead (FND), Half Nodes Dead (HND), Last Node Dead (LND), energy consumption, throughput, and stability period as evaluation criteria, and further validated in a precision agriculture IoT setting. The anticipated improvements of 15–40% in network lifetime and 20–30% in throughput are expected to confirm HSF-CAR as a dependable solution for energy-aware heterogeneous WSN deployment.

Keywords: Wireless Sensor Networks, Heterogeneous Networks, Energy-Efficient Clustering, Adaptive Multi-Hop Routing, Hybrid Metaheuristic Optimization, Spotted Hyena Optimizer, Firefly Algorithm, Internet of Things.

ICEMSET-2026/ST/1317

Emerging Biomedical Approaches in Iron Supplementation: Advances in Iron Delivery Systems for Improved Bioavailability and Therapeutic Efficacy

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Abstract

Iron Deficiency Anaemia (IDA) is a big public health problem worldwide. Poor gastrointestinal tolerance and food interactions and variable absorption make conventional oral ferrous salts less effective. With the development of new biomedical sciences and nanotechnology, novel approaches to iron delivery have appeared, which seek to increase the bioavailability and minimize the side effects. This paper focuses on new technologies, such as liposomal iron, sucrosomial iron, iron nanoparticles, iron loaded with ferritin and microencapsulated iron. The iron stability, transport and intestinal uptake of these systems is enhanced by lipid

carriers, biocompatible nanomaterials and protective encapsulation. It also highlights the regulation of iron absorption by hepcidin, ferroportin, divalent metal transporter 1 and gut microbiota. A comparison is suggested for conventional and advanced formulations based on haemoglobin, serum ferritin, and transferrin saturation. The methods hold promise for overcoming the limitations of traditional supplementation. A molecular understanding of the regulation of iron balance coupled with the use of sophisticated delivery technologies has the potential to create safer, more effective and tailored iron therapy. It require further clinical research to establish their long-term safety, effectiveness and feasibility for preventing and controlling iron deficiency anaemia.

Keywords: Iron supplementation, Liposomal iron, Sucrosomial iron, Nanoparticle-based delivery, Iron bioavailability, Iron deficiency anaemia.

ICEMSET-2026/ST/1318

Dosage-Aware Drug–Drug Interaction Prediction Framework with Organ-Level Risk Analysis and Interactive Clinical Visualization

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Abstract

Drug–drug interactions (DDIs) are a significant concern for patients receiving multiple medications. This work presents DDI Predictor, a machine-learning-based framework designed to assess potential interactions by considering both molecular characteristics and prescribed drug dosages. Molecular structures are represented using Morgan fingerprints, while dosage information is incorporated into the prediction workflow. The accompanying Streamlit application allows users to enter medication details, analyse drug combinations, and examine potential organ-level effects through an interactive visualisation interface. It also supports prescription parsing and generates natural-language explanations to help users interpret the analysis. The framework separates machine-learning predictions from its rule-based organ-risk assessment and language-model-assisted explanation components. The system is intended as a research prototype for exploring dosage-aware drug-interaction analysis and clinical decision-support interfaces. Its outputs require further validation and should not be treated as medical advice or a substitute for professional clinical judgement.

Keywords: Drug–drug interaction; dosage-aware prediction; Morgan fingerprints; machine learning; organ-level risk analysis; clinical decision support.

ICEMSET-2026/ST/1319

AI and Machine Learning-Based Fake Wi-Fi Detection and Alert System

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Abstract

The widespread use of public and private wireless networks has increased the risk of fake Wi-Fi access points and Evil Twin attacks, in which a malicious access point imitates a legitimate network to mislead users. This project proposes an artificial intelligence and machine learning-based system to identify potentially suspicious Wi-Fi networks and alert users. The system examines available network characteristics, including Service Set Identifier (SSID), Basic Service Set Identifier (BSSID), signal strength, security type, channel, and frequency. These features are used by a Random Forest classification model to distinguish networks labelled as safe or suspicious, based on the dataset and labels used for training. The proposed approach aims to support users in recognizing potentially unsafe wireless access points before connecting to them. The system presents the classification outcome and provides an alert when a network is identified as suspicious. By combining wireless-network feature analysis with machine learning, the project explores a practical approach to improving awareness of Wi-Fi security threats. Its effectiveness is to be evaluated using the prepared dataset and appropriate classification measures.

Keywords: Fake Wi-Fi Detection, Evil Twin Attack, Machine Learning, Random Forest, Wireless Network Security.

ICEMSET-2026/ST/1320

A Review: Synthesis and Structural Characterisation of Graphite-Derived Nanomaterials

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Abstract

Among the graphene analogues, reduced graphene oxide (rGO) has been the most widely available as a solution-processable material, but its material characteristics have been dictated through a sequence of three chemical choices: the oxidation of graphite; exfoliation of the resultant graphite oxide material; and the reduction of the oxygen-functionalized layers. This review article traces that sequence from beginning to end. We begin by defining graphite, graphene, graphite oxide, graphene oxide (GO), and rGO in terms of the nomenclature suggested by the Carbon editorial board, and progress to a comparison of the oxidation routes of Brodie, Staudenmaier, Hofmann, Hummers, modified Hummers and improved (Tour) in combination with a mechanistic understanding whereby the oxidation process goes through a stage-1 intercalation compound followed by a pristine intermediate of graphite oxide. Exfoliation and reduction are then reviewed according to method class and the diagnostic signatures of each material are compiled for X-ray diffraction, Raman, FTIR,, infrared, X-ray photoelectron, electron microscopy, atomic force, and UV–visible measurements, with numerical values selected from several independent studies listed alongside each other. The correlations with C/O ratio, defect density, interlayer spacing, band gap, conductivity and device behaviour are then discussed, before applications in energy storage, sensing, flexible electronics, opto-electronics, photocatalysis, adsorption and membranes follow. We conclude by the outstanding problems of incomplete deoxygenation, defect control, batch-to-batch variability, hazardous reagents, restacking, scale-up and the lack of reporting standards, before outlining the research pathways towards safer oxidation, greener reduction, in situ monitoring and application-specific design.

Keywords: graphene oxide; reduced graphene oxide; Hummers method; chemical reduction; Raman spectroscopy; XPS; structure–property relationships.

ICEMSET-2026/ST/1321

Analysis of Energy-Efficient Graphene-Based Schottky Junction Silicon Solar Cell Structures for Next-Generation Optical Applications

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Abstract

This work presents a comparative analysis of an n-doped silicon substrate with different anti-reflecting coating (ARC) material over graphene over SiO2 dielectric for their solar cell performance. Different materials that can be used for the passivation of light and that helps in modulating the electrical behavior in the device have been used for analysis in this work. It is observed that Graphene Oxide as the ARC exhibit improved performance among all the different ARC material used like Si_3N_4, Al_2O_3, and TiO_2. The parameters that have been used for the comparative analysis include, open circuit voltage (VOC), the current density (Jsc), the fill factor (FF) and the power conversion Efficiency (PCE). The graphene oxide ARC based-solar cell exhibited an efficiency >7.70% which is almost 45% above the reported designs. This solar cell can find use as an optical sensors and photovoltaic device which can be used to supply power to small electronic device.

Keywords: graphene, graphene oxide, silicon solar cell, Schottky junction, power conversion efficiency, TCAD simulation, ARC.

ICEMSET-2026/ST/1322

Numerical Modeling of a DPP-R16-Based p-Channel OTFT: Effect of Channel Length and Tail-like Density of States

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Abstract

Localized electronic states and interfacial charge have significant impact on the electrical characteristics of organic thin-film transistors (OTFTs). In this work, we developed a 2D numerical model of a p-channel DPP-R16 OTFT, based on an experimental device, using Silvaco VICTORY DEVICE. An ideal device without defects shows a mobility of 6.75×10^{-3} $cm^2V^{-1}s^{-1}$ whereas the experimental mobility is 1.13×10^{-2} $cm^2V^{-1}s^{-1}$. By adding doping, defect and interface charge successively the threshold voltage changed from 0.167 V to −28.37 V. The calibrated device gives a mobility of 5.86×10^{-3} $cm^2V^{-1}s^{-1}$, a subthreshold slope of 2.39 $Vdec^{-1}$ and an I_{ON}/I_{OFF} ratio of 2.94×10^5. After this, the channel length is changed from 40 to 160 μm and the tail-state parameters are modified. The device electrical characteristics are affected by the donor-like tail-state density and decay energy, while the acceptor-like parameters have small effects in the evaluated ranges. These results show the sensitivity of DPP-R16 based OTFTs to the energy distribution of localized states.

Keywords: Organic thin-film transistor; DPP-R16; TCAD simulation; density of states; tail states.

ICEMSET-2026/ST/1323

Comparative Structural Evolution of Pristine, Mg- and Cu-Substituted P2-Type $Na_{0.67}MnO_2$ Cathode Materials for Sodium-Ion Batteries

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Abstract

The growing demand for sustainable energy-storage technologies has encouraged research into sodium-ion batteries as alternatives to lithium-ion batteries. Among potential cathode materials, layered transition-metal oxides are promising due to their structural flexibility and sodium-storage capability. This study investigates pristine P2-type $Na_{0.67}MnO_2$ and Mg- and Cu-substituted compositions, $Na_{0.67}Mn_{1-x}Mg_xO_2$ and $Na_{0.67}Mn_{1-x}Cu_xO_2$, (x = 0.05, 0.10 and 0.15), prepared through a conventional solid-state reaction method. Their structural characteristics are examined using X-ray diffraction (XRD) and Rietveld refinement. The investigation focuses on phase formation, crystallographic symmetry, diffraction peak shifts, lattice parameters and unit-cell volume. Particular emphasis is placed on evaluating the effects of dopant type and concentration on the crystal structure and stability of the layered framework. The comparative analysis provides insights into structural modifications induced by Mg and Cu substitution, offering a foundation for further investigations of layered oxide cathodes for sodium-ion batteries.

Keywords: Sodium-ion batteries; P2-type $Na_{0.67}MnO_2$; Magnesium substitution; Copper substitution; Layered transition-metal oxides.

ICEMSET-2026/ST/1324

Plant Disease Detection and Image Enhancement: A Comparative Evaluation of Original, CLAHE, and GAN-Enhanced Images Using YOLO

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Abstract

Automated plant disease detection is influenced by image quality factors such as contrast, illumination, noise, texture, and disease related structure visibility. This paper compares Original, Contrast Limited Adaptive Histogram Equalization (CLAHE) enhanced, and Generative Adversarial Network (GAN) enhanced images using a YOLO based plant disease detection framework. The study uses 2,565 labeled images, comprising 1,979 training, 347 validation, and 239 test images. Image quality is evaluated using Peak Signal to Noise Ratio (PSNR), while salt and pepper noise is investigated at densities ranging from 10% to 90%. Multiple YOLO configurations are evaluated using Precision, Recall, mAP@0.50, and mAP@0.50:0.95. GAN enhancement achieves a test PSNR of 33.6999 dB compared with 21.8611 dB for CLAHE. Among enhanced conditions, YOLO12s with GAN achieves the highest mAP@0.50:0.95 of 0.4235. However, the Original dataset achieves the highest overall detection performance, with YOLO12s reaching 0.4384. These findings demonstrate that improved image quality does not necessarily lead to improved downstream disease detection performance.

Keywords: Plant disease detection; Image enhancement; CLAHE; Generative adversarial network (GAN); YOLO.

ICEMSET-2026/ST/1325

Solar-Powered Smart Environmental Surveillance: Integrating Next-Generation Photovoltaic Harvesting with Real-Time Air-Water Monitoring Ecosystems

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Abstract

Environmental pollution and increasing energy demands necessitate intelligent, sustainable, and autonomous monitoring solutions. This research proposes a solar-powered smart environmental surveillance ecosystem integrating next-generation photovoltaic (PV) energy harvesting with real-time air and water quality monitoring. The framework combines high-efficiency PV technology, intelligent battery management, and adaptive energy optimization to ensure uninterrupted operation under variable environmental conditions. An IoT-enabled sensor network monitors critical air pollutant (PM2.5, PM10, CO, NO_2) and water quality indicators (pH, turbidity, dissolved oxygen, and electrical conductivity). Real-time data acquisition, wireless communication, cloud-based analytics, and intelligent anomaly detection enable continuous pollution assessment and early-warning generation. A coordinated energy management strategy optimizes power generation, storage, and sensor operation while enhancing system reliability. Performance evaluation focuses on energy autonomy, photovoltaic efficiency, sensing accuracy, and monitoring reliability. The proposed architecture establishes a scalable, low-carbon environmental intelligence platform for industrial, urban, agricultural, and remote ecosystems.

Keywords: Solar PV, Environmental Surveillance, IoT, Air–Water Monitoring, Energy Optimization, Anomaly Detection.

ICEMSET-2026/ST/1326

An Extended BEROA Architecture for Slice-Aware Resource Allocation and Admission Control in 5G and Beyond-5G Networks

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Abstract

Fifth-generation and beyond-fifth-generation networks must serve broadband, ultra-reliable low-latency and massive machine-type services over shared infrastructure, each with distinct quality-of-service needs. A hybrid method combining the Al-Biruni Earth Radius and Remora optimization algorithms with deep-Q-network admission control has improved resource allocation and call admission, but it treats the network as a single

resource pool, lacks explicit network slicing and cannot react to service-level violations. This paper proposes an extended, modular architecture with five cooperating layers: data acquisition, slice management, slice-aware resource allocation, per-slice admission control, and closed-loop monitoring. The optimizer uses per-slice resource encoding and quality-of-service penalties, while slice-specific admission thresholds protect ultra-reliable traffic and maximize machine-type connectivity. A qualitative comparison and complexity analysis show that slice awareness adds only a small, linear overhead. An empirical evaluation plan is outlined as future work.

Keywords: 5G; Beyond-5G; Network slicing; Resource allocation; Admission control.

ICEMSET-2026/ST/1327

Hybrid Framework for Coordinated PEV Power Delivery and Loss Minimization in Radial Distribution Networks

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Abstract

Plug in electric vehicles (PEVs) increase peak demand when vehicles charge at same instant cause to raises feeder current, increases line losses and causes voltage drops particularly in radial distribution networks. Coordinated vehicle to grid (V2G) operation reduce these problems but feeder loss, voltage and additional load margin need to be evaluated together. The approach is applied to a reduced 10 bus feeder derived from the IEEE 33 bus system with a PEV station at Bus 6 using particle swarm optimization (PSO) and backward forward sweep (BFS) load flow. At peak demand 500 kW V2G injection reduces active power loss from 10.38 to 4.12 kW (60.31%). Minimum bus voltage increases from 0.980 to 0.987 p.u., and voltage deviation decreases by 35%. Additional load margin rises from 200 to 700 kW (250%). The results demonstrate improved feeder performance through local PEV support.

Keywords: Plug in electric vehicle; Vehicle to grid; Particle swarm optimization; Backward forward sweep; Radial distribution network.

ICEMSET-2026/ST/1328

A Comparative Review of FSM-Based Traffic Control, Smart Parking, and Adaptive Street Lighting for Integrated Smart Cities

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Abstract

Urban infrastructure is increasingly required to respond to changing mobility patterns, limited parking capacity, and energy-efficiency requirements. This review examines three related smart-city applications: finite-state-machine (FSM) based traffic control, smart parking, and adaptive street lighting. The systems are compared in terms of sensing techniques, embedded platforms, communication technologies, control strategies, advantages, and deployment limitations. Existing studies show that low-cost controllers, networked sensors, and Internet of Things (IoT) connectivity can support responsive traffic signals, occupancy-aware parking, and demand-based lighting. Artificial intelligence, edge computing, and renewable-energy integration provide further opportunities for prediction, low-latency processing, and energy management. However, common challenges include sensor uncertainty, communication failures, fragmented architectures, cybersecurity, privacy, cost, maintenance, and limited scalability from prototypes to urban deployment. Based on these findings, an integrated conceptual architecture is formulated in which traffic, parking, and lighting modules communicate through a shared IoT coordination layer. Interoperability, selective data sharing, affordability, security, and scalability are identified as important directions for future smart-city development.

Keywords: Smart city, Internet of Things, finite-state machine, traffic signal control, smart parking, adaptive street lighting, embedded systems, wireless sensor networks, urban automation.

ICEMSET-2026/ST/1329

Influence of Fe and Mo Additives on the Structural Properties and Phase Evolution of Nanocrystalline Co_3O_4 Thin Films

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Abstract

Nanocrystalline cobalt oxide (Co_3O_4) thin films are promising p-type semiconductor materials for electronic and gas-sensing applications. This study examines the influence of iron (Fe), molybdenum (Mo), and combined Fe–Mo additions on the phase formation and microstructure of Co_3O_4 thin films. Fe-modified, Mo-modified and co-modified films were prepared at 450 °C, followed by annealing at 500 °C for 2 h. Grazing-incidence X-ray diffraction confirmed cubic spinel Co_3O_4 (Fd-3m) in all measurable films. The Fe-modified sample showed no detectable secondary iron-oxide phase, whereas Mo-containing films exhibited an additional reflection near 2θ = 12.7–12.9°, consistent with the (020) plane of orthorhombic α-MoO_3. Scherrer crystallite sizes were 11.0–12.7 nm for undoped films, 12.9 nm for Fe-modified films, 10.7–11.6 nm for Mo-modified films, and 8.8 nm for the Fe–Mo co-modified film. These findings demonstrate distinct effects of Fe and Mo on phase stability and grain growth and provide a structural basis for further investigation of electronic transport and gas-sensing characteristics. Details are presented.

Keywords: Co_3O_4 thin films, Fe and Mo additives, X-ray diffraction, Nanocrystalline materials, Gas sensing, Phase stability.

ICEMSET-2026/ST/1330

Machine Learning-Assisted Parameter Optimization Technique for Memory Decoder Circuit in 32 nm CMOS Technology

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Abstract

Address decoders dictate access latency and switching power dissipation in modern memory architectures. This work presents a blend of Gate Diffusion Input (GDI) and Dual Value Logic (DVL), a low power switching technique, intended at improving the efficiency of 2:4 address decoder by optimizing power consumption, propagation delay and area of the device. The simulated decoder module with (14-T) transistors, attains optimum outputs while sustaining low power and compact area requirements. The decoder module is implemented in LT-Spice, an open source TCAD software, with 32 nm planar CMOS PDK and evaluated for average power consumption, propagation delay and area. The purpose of this work is to provide a unified platform for comparative analysis of various logic design techniques and automate parameter synthesis using machine learning, which were earlier evaluated in fragmented, non-uniform technology nodes relying on trial and error SPICE simulations sweeps. Comparison with existing logic designs such as static CMOS, PTL, TGL and mixed logic indicate that DVL and GDI logic reduced average power consumption by 33.3% (0.840 µW) , 37.77% (8.09ps) reduction in average propagation delay and significant hardware minimization. The results suggest the module's potential for low power, low latency for portable VLSI memory applications.

Keywords: Decoder Module; CMOS; Optimization; Machine Learning; Low Power.

ICEMSET-2026/ST/1331

Design of a DRV8701-Based Smart Gate Motor Driver for DC Motor Control

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Abstract

The project completely presents the design and functionality of a smart gate driver-based motor driver for efficient DC motor control. The project includes the Texas Instruments DRV8701 gate driver and a highly efficient H-bridge consisting of AOD4184A N-channel MOSFETs. The key feature of this project is the technical usage of appropriate resistors and capacitors for the efficient functioning of the entire motor driver system with hardware level protection mechanisms which include automatic shoot-through prevention via an adaptive dead-time control and precise over current reduction. This entire project is based on conjuring an efficient interface between STM32F103x microcontroller and BO motors. The design of this driver implements a customised voltage reference network and a 0.1 ohm current-sense shunt, by doing so the driver achieves a stall current of 1 ampere. By locking the stall current, the motor load and the switching components are safeguarded during high-torque and locked-rotor conditions. An AMS1117-3.3 low dropout regulator is used to ensure stable 3.3V digital communication for PWM speed control, phase direction switching and fault-flag reporting. The entire design has been designed using KiCAD and validated for Electrical Rules Check (ERC) compliance multiple times. This architecture provides a scalable, fault-tolerant solution for embedded robotics and precise mechatronics operating within a 7.4V to 12V range.

Keywords: DRV8701, H-Bridge, STM32, Motor Control, Hardware Protection, Shoot Through Prevention.

ICEMSET-2026/ST/1332

Structural, Optical and Magnetic Properties of Green Synthesized g-C_3N_4/NiO Nanocomposite

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Abstract

In this study, graphitic carbon nitride (g-C_3N_4) and NiO nanoparticles were synthesize by green-assisted approach and combustion method respectively. Subsequently, the synthesized materials were combined to fabricate the g-C_3N_4/NiO nanocomposite. The structural, morphological, and magnetic properties of nanocomposite was investigated by various characterization techniques. The HR-XRD analysis confirmed the crystallite size decreases of the nanocomposite as compared to bare NiO. Due to decrease in the crystallite size, the specific surface area decreases which is crucial parameter for the energy storage as well as photocatalytic applications. The FE-SEM images clearly shows the decrement in the particle size of the nanocomposite. For the optical properties FTIR and DRS techniques were employed which confirms the presence of functional group at the surface and bandgap of the synthesized material. EDAX and XPS techniques confirms the purity of the material as well the successful incorporation of NiO nanoparticles into the 2D-gC_3N_4. In addition, explore the energy storage properties of g-C_3N_4/NiO nanocomposite-based electrode for super capacitor applications.

Keywords: gC_3N_4/NiO, Nanocomposite, HR-XRD, BET, Crystallite size.

ICEMSET-2026/ST/1333

The Status of Indian Semiconductor Industry: Domestic Developments, Global Dependencies and the Transition Towards Self-Reliance

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Abstract

In the earlier days, India remained dependent upon other countries for the Semiconductor devices, Manufacturing equipments, materials and advancement technologies. This Dependency for Semiconductor Goods increased the need to strengthen domestic manufacturing and reduce the supply chain risks. Despite the growth of the Semiconductor industry, the country faces challenges in becoming self-Reliant in Semiconductor manufacturing. This paper reviews the evolution and recent development of the Indian Semiconductor industry particularly about the launch of the India Semiconductor Mission (ISM). It covers the major segment of semiconductor industry, including wafer fabrication, chip design, assembly, testing and packaging (ATMP/OSAT), materials, equipments and research and development. This study also highlights the major domestic and manufacturing iniatives and collaboration with the International partners and resources. It further discusses the challenges such as investment on the India Semiconductor mission (ISM), Infrastructure technology transfer and skilled workforce availability. At last it also highlights the steps and opportunities for strengthening India's Semiconductor industry with the vision to start its own manufacturing production house and start exporting goods from India and moving towards greater self-Reliance.

Keywords: Indian Semiconductor Industry, India Semiconductor Mission, Semiconductor Manufacturing, Self-Reliance, ATMP/OSAT.

ICEMSET-2026/ST/1334

AI-Based Payload-Aware Cover Image Selection and Content-Adaptive Image Steganography Using AES-GCM Encryption

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Abstract

Secure communication requires protecting confidential information while preserving the visual quality of carrier images. Image steganography hides secret data within digital images, while encryption protects the data itself. This work aims to develop an AI-assisted image steganography framework that automatically selects suitable cover images according to image characteristics and secret payload size. The framework analyses multiple image features and ranks candidate images to identify an appropriate cover for embedding. Before hiding, the secret information is encrypted using Advanced Encryption Standard in Galois/Counter Mode (AES-GCM), which provides confidentiality and authentication. The encrypted payload is then embedded into selected image regions using a content-adaptive technique. The approach combines automated cover selection, adaptive data hiding, and cryptographic protection to support secure image-based communication while aiming to preserve visual quality. The framework is evaluated using image quality metrics, embedding capacity, and data recovery measures. The results will be reported after experimental testing and overall reliability.

Keywords: AI-Based Image Steganography, AES-GCM Encryption, Payload-Aware Cover Selection, Multi-Feature Analysis, Content-Adaptive Embedding.

ICEMSET-2026/ST/1335

Green Synthesis of Graphene Oxide and Fabrication of GO–PVA Nanocomposite Films for Improved Mechanical Properties

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Abstract

Instead of relying solely on dangerous chemicals, graphene oxide (GO) can be produced in an environmentally safe manner using natural resources, plant extracts, microbes, and other biological components. This study attempts to create ecologically friendly graphene oxide nanocomposites using pineapple leaves, orange peel and rice bran the furtherly treated with ferrocene and acid washing gives graphene oxide (GO) powder. Using this

graphene oxide (GO) nanoparticle eco-friendly natural biomass GO-PVA nanocomposite film were synthesized. GO-PVA nanocomposites offer a sustainable route to high-performance multifunctional materials for next-generation engineering applications. For evaluating the structural and chemical properties of the synthesize of GO-PVA nanocomposite films SEM, TEM, XRD, FTIR characterization were used and mechanical properties were also studied. Thus, the GO-PVA nanocomposite films show great potential for advanced functional applications and this study demonstrates that green-synthesized GO effectively reinforces PVA, resulting in high-performance, biodegradable nanocomposite films.

ICEMSET-2026/ST/1336

AI Based Medical Report Analyzer with Disease Risk Prediction and Personalized Health Recommendation

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Abstract

A patient's understanding of their own historical medical data is often limited by niche jargon and unintuitive raw data in their medical records. This work proposes a Medical Report Analyzer to identifies abnormal parameters in medical records and explains their health implications. The proposed medical report analyzer is implemented by using efficient machine learning techniques. Our proposed system is implemented as a web application that employs OCR to extract relevant parameters from the input medical report uploaded as pdf file. Our proposed application is implemented by using five machine learning models namely Logistic Regression, Random Forest, SVM, XGBoost, and MLP neural network to detect the risk of diabetes, heart disease, kidney disease, liver disease, and anaemia. Furthermore, SHAP is also employed to isolate the driving features of each model. The proposed application integrates XAI and data visualization to summarize the results. Additionally, this system provides a personalized health score and recommendations regarding when to consult a health professional, making preliminary health assessment more transparent and accessible.

Keywords: Artificial Intelligence; Machine Learning; Optical Character Recognition; Disease Prediction; Explainable AI.

ICEMSET-2026/ST/1337

Sustainable Fabrication of PVA–GO Nanocomposite Films with Enhanced Mechanical Properties

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Abstract

Instead of relying solely on dangerous chemicals, graphene oxide (GO) can be produced in an environmentally safe manner using natural resources, plant extracts, microbes, and other biological components. This study attempts to create ecologically friendly graphene oxide nanocomposites using pineapple leaves, orange peel and rice bran the furtherly treated with ferrocene and acid washing gives graphene oxide (GO) powder. Using this graphene oxide (GO) nanoparticle eco-friendly natural biomass GO-PVA nanocomposite film were synthesized. GO-PVA nanocomposites offer a sustainable route to high-performance multifunctional materials for next-generation engineering applications. For evaluating the structural and chemical properties of the synthesize of GO-PVA nanocomposite films SEM, TEM, XRD, FTIR characterization were used and mechanical properties were also studied. Thus, the GO-PVA nanocomposite films show great potential for advanced functional applications and this study demonstrates that green-synthesized GO effectively reinforces PVA, resulting in high-performance, biodegradable nanocomposite films.

ICEMSET-2026/ST/1338

Design and Electrochemical Evaluation of Hybrid Nanostructured Electrodes for Sustainable Energy Generation from Compost-Based Microbial Fuel Cells

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Abstract

Microbial fuel cells (MFCs) offer a sustainable approach for converting the chemical energy stored in organic substrates into electrical energy through microbial activity. In the present study, the performance of a membrane-less compost-based MFC was investigated using nanomaterial-modified copper electrodes, comprising a NiCo-layered double hydroxide (NiCo-LDH) anode and an electrochemically deposited SnO_2/polypyrrole (SnO_2/PPy) cathode. The structural, morphological, and compositional characteristics of the modified electrodes were examined using X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDS). The operating conditions were optimized by incorporating 2 mL of 2 M KCl and 3 mL of 10 M urea into 9 g of compost. Electrochemical investigations demonstrated improved charge-transfer characteristics of the modified electrode configuration, exhibiting a charge-transfer resistance of 58.85 Ω compared with 127.31 Ω for the bare Cu–Cu system. The modified MFC achieved a maximum open-circuit potential of 161.41 mV, a power density of 38.15 mW m^{-2}, and a current density of 388.2 mA m^{-2}, indicating a significant improvement in electrical performance. Sterilization experiments further established the essential contribution of naturally occurring microorganisms to electricity generation, whereas urea acted as an additional electroactive substrate and KCl improved ionic conductivity. Furthermore, the modified electrode demonstrated satisfactory electrochemical stability over 200 consecutive cycles. Overall, the findings highlight the potential of NiCo-LDH and SnO_2/PPy-based hybrid electrodes for improving the electrochemical performance of compost-based microbial fuel cells.

Keywords: Microbial fuel cell; Compost-based bioelectrochemical system; NiCo-LDH; SnO_2/PPy nanocomposite; Urea; Power generation.

ICEMSET-2026/ST/1339

Exploring Two-Dimensional MnB Monolayer for Solid-State Hydrogen Storage: A DFT Study

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Abstract

The growing energy demand prompted the scientific community to develop alternative energy resources. Hydrogen is recognized as promising clean energy carrier for the future due to its high energy density, abundance nature and environmental friendliness since water is the only byproduct after its consumption. However, the practical utilization of hydrogen is limited by its safe and efficient storage. The traditional storage of hydrogen involves high pressure compression and cryogenic liquefaction techniques, these techniques have high risks in terms of safety. Therefore, there is need of development of new materials for solid state hydrogen storage for the rapid growth of hydrogen economy in the energy sector. In this work, we examine the hydrogen storage capacity of MnB monolayer, which is an MBene material. we conduct a systematic analysis of the structural stability, electronic properties and hydrogen adsorption properties of MnB using density functional theory (DFT).

ICEMSET-2026/ST/1340

Quantum Dot Fluorescence Probes for TNBC Microenvironment Biomarkers

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Abstract

Triple-negative breast cancer (TNBC) has high immune infiltration, inflammatory signaling, stromal heterogeneity, and metabolic changes, as well as a demand for molecular tools to identify biomarkers associated with the tumor microenvironment. Functionalized quantum dots (QDs) have optical properties that depend on the size and surface, providing sensitive optical detection. This chapter summarizes the critical review of the probes for the identification of cytokines, proteases, markers of extracellular vesicles, and signals associated with metabolites relevant to TNBC that utilize QD technology. It discusses the mechanism of fluorescence such as surface defects, ligand conjugation, quenching, Förster resonance energy transfer, resistance to photobleaching, and auto-fluorescence in tissues. The functionalization by antibodies, peptides and aptamers is examined with respect to the ability to specifically bind to the target, binding affinity, steric accessibility, non-specific adsorption, and protein corona formation. Biological variability, analytical controls, machine-learning assisted signal analysis and spectral calibration are also discussed. Moreover, cytotoxicity, biodistribution, clearance and limitations of *ex vivo* vs *in vivo* imaging are discussed. Last, the analytical validation, reproducibility, biosafety and clinical relevance of the use of QD-based probes in a reliable diagnostic application of TNBC are highlighted. This chapter is proper aligned with SDG-3 (Good health and well-being).

Keywords: Triple-negative breast cancer; Quantum dots; Tumor microenvironment; Fluorescence probes; Biomarker specificity; Optical imaging.

ICEMSET-2026/ST/1341

Attention-Based Feature Fusion of AlexNet and EfficientNet-B0 for Breast Cancer Detection Using Mammographic Images

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Abstract

Early detection of breast cancer is crucial for better diagnosis and prompt medical treatment. Mammographic image analysis is very important to identify breast abnormalities, but the accurate classification is challenging due to variations in breast tissue density, lesion shape and image contrast. Deep learning models have shown promise in medical image analysis, especially in extracting useful features from mammographic images. But different single convolutional neural networks may capture different aspects of the image information. In this work, we propose a hybrid deep learning framework for breast cancer detection that combines AlexNet and EfficientNet- B0 with an attention-based feature fusion mechanism. The proposed framework employs two parallel CNN branches to extract complementary features from mammographic images. We use AlexNet to capture spatial and visual patterns, and EfficientNet-B0 to extract deeper feature representations because of its efficient network architecture . The extracted features are concatenated by an attention based fusion mechanism which assigns importance to relevant feature representations for classification. The proposed framework is evaluated through accuracy, precision, sensitivity, specificity, F1-score and confusion matrix. This study investigates the potential of attention-based fusion of complementary features from AlexNet and EfficientNet-B0 for better classification performance than that of the individual network architectures. For computer-aided breast cancer detection, we combine the attention-based feature fusion and Grad-CAM to improve the feature representation and enhance the interpretability.

Keywords: Breast Cancer Detection, Mammographic Images, CBIS-DDSM, AlexNet, EfficientNet-B0, Attention-Based Feature Fusion, Grad-CAM, Hybrid Deep Learning.

ICEMSET-2026/ST/1342

AI Profiling of Biocorrosion Biofilms with Nanomaterial Sensors

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Abstract

Microbiologically influenced corrosion comes from electrochemical reactions and the mixed biofilms that can change metal surfaces. Traditional monitoring usually cannot track activity, local changes in chemicals and early damage to materials. This chapter looks at nanomaterial-based sensors and explainable artificial intelligence as tools to help understand the communities that cause corrosion in water systems and industrial structures. Sulfate-reducing and iron-oxidising microorganisms, fungal biofilms and polymicrobial communities are considered in relation to polymeric substances (EPS) electron transfer, oxygen gradients and corrosion-product formation. Biological information has been gathered using microscopy, proteomic and electrochemical techniques. Sensor data has been combined with environmental data using random forests, gradient boosting and interpretable time series models. Training these systems needs to deal with amounts of data, similar samples, confusing conditions and the need to work with metals or different water types. Problems such as sensor aging, changes in calibration, buildup on the sensors and tiny particles coming off are talked about as real-life challenges. The chapter makes a difference between predicting if corrosion is likely and proving whether a specific microorganism is behind it. The framework combines biofilm controls, standardized corrosion coupons, electrochemical validation and reproducible pipelines to support timely risk assessment and evidence-based maintenance decisions, and the collected observations across various alloys and operating regimes will be required to determine whether proposed intelligent sensors improve the early intervention compared with the established monitoring approaches. The entire work has been performed in alignment with SDG 9.

Keywords: Microbiologically influenced corrosion; Biofilms; Nanomaterial sensors; Electrochemical impedance; Explainable AI; Predictive monitoring.

ICEMSET-2026/ST/1343

Explainable AI and Nano-Enabled Liquid Biopsy for Bladder Cancer Diagnosis

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Abstract

Effective detection and monitoring tools are required for bladder cancer. Urinary biomarkers provide opportunities for non-invasive disease analysis. Integration of nanotechnology with explainable artificial intelligence can aid detection and interpretation of urinary biomarkers. This chapter will discuss the potential of extracellular vesicles, tumor-associated nucleic acids, proteins and metabolites for diagnosis. Multi-omics data can be used to aid integration of data to develop robust molecular signatures. Explainable machine learning can provide insight into feature stability and prediction ability to classify subgroups of patients. However, high feature importance does not automatically indicate that the biomarker is biologically relevant. We will discuss several approaches to biomarker detection; functionalized quantum dots, gold nanoparticles, carbon-based materials and electrochemical nanostructures. Urine concentration, blood, infection and storage conditions may affect performance. Analytical and clinical validation should assess detection limits, selectivity, accuracy, reproducibility, sensitivity and specificity. An approach has been proposed where biomarkers can be identified using computational techniques and confirmed using orthogonal methods. Blind validation should also be considered. Studies should be carried out to reduce false positive results and ensure cancer specific signals are

detected and not from inflammatory changes. By collecting sequential samples, it can be seen how biomarkers change post-treatment. This chapter provides a framework for validating AI driven nanobiosensors for bladder cancer diagnosis and monitoring, aiding Sustainable Development Goal 3 (Good Health and Well-being).
Keywords: Bladder cancer; Urinary liquid biopsy; Explainable AI; Nanobiosensors; Biomarker validation.

ICEMSET-2026/ST/1344

Wearable Nanofiber Biosensors for Metabolic Health Monitoring

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Abstract
Wearable biosensors are on their way - but we need to understand the data Sweat, interstitial fluid and blood differ in their properties, particularly for analyte concentration over time, dynamic range and interfering effects. Electrospun nanofibers provide a high surface area, flexible porosity and a soft interface for coupling molecular recognition with wearable transducers. We examine the influence of biopolymer properties, fiber diameter, orientation, crosslinking, surface treatment, loading of nanomaterials on biomarker stability, analyte transport and sensor response, as well as how the fiber morphology affects optical and electrochemical signals. Glucose, lactate, electrolytes, and select markers of inflammation are discussed. Various device geometries, including the flexible electrodes, microfluidic sampling devices, flexible membranes, and the wireless sensors, are discussed in the relation to sampling efficiency, contamination, damage potential, and flexibility, as well as the number of sensing layers. Artificial intelligence approaches to the artifact correction, calibration, drift correction, data compression, and signal fusion are evaluated, and their limitations across individuals and activities are considered. Factors such as biocompatibility, impact of humidity and temperature, dependence of readings on sweat rate, adhesion, electrical safety, reproducibility, and use span are reviewed. Despite lab testing proving high sensitivity of the sensor this is not always reflected in the accuracy of the reading. This section also looks at how samples are collected, how Continuous Monitoring and the skin contact differ and the impact a single user can have on readings. These devices must be tested properly before the selling in the market of the healthcare sector.

Keywords: Electrospun nanofibers; Wearable biosensors; Sweat sensing; Metabolic health; Signal processing; Flexible electronics.

ICEMSET-2026/ST/1345

Microbiome–Neuroinflammation Networks for Targeted Nanomedicine

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Abstract
The microbiota gut brain axis integrates microbial microbolism, barrier function in intestine, peripheral immunity, and neutoinflammatory pathways which got implicated in progressive neurological disease. However, sole organism microbial taxa rarely provide resilient mechanistic description across various samples, whereas computational correlations can be altered by sampling and clinical variability. This chapter assesses network-based strategies for determining microbiome, metabolism which may facilitate targeted nanomedicine. The use of systems biology and explainable machine learning allows the analysis of multilayer graphs that connect microbial genes, metabolites, cytokines, host transcripts, and neuronal pathways. The observation is primarily focused on four processes: microglial activation, intestinal permeability, oxidative stress, and inflammatory signaling. The development of biodegradable nanocarriers, composed of lipid and targeting ligand, enables the delivery of future anti-inflammatory drugs. The molecular docking and molecular dynamics

approaches can help in studying molecular interactions. The experimental tests are needed to verify the developed formulation, check its cellular uptake, and assess target activity. This chapter offers evidence-based criteria for selecting network nodes and assessing whether nano enabled interventions alter disease relevant mechanisms. Further research must create vigorous and external prospective multicenter machine like quantitative preclinical validation.

Keywords: Neuroinflammation, Microbiome networks, Targeted nanomedicine, Systems biology, Nanocarriers, Machine learning.

ICEMSET-2026/ST/1346

An Integrated Computational Framework for Nanomaterial Toxicity Assessment Using Machine Learning

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Abstract

Nanomaterials toxicity is highly dependent on physico-chemical composition, surface functionality of the surfaces, the route of exposure, the biological model used and the conditions of testing, making predictions between studies difficult. A framework that is reproducibility-centric is used to create interpretable nanotoxicity models for a variety of data sets in R and Python. The datasets include particle identification, dose units, size, hydrodynamic diameter, state of aggregation, surface charge, coating chemistry and biological endpoints. The grouped cross-validation model is used to evaluate the performance of the linear regression, random forest and gradient boosting models and the uncertainty aware model to reduce the data leakage caused by formulations and laboratories. Generalization to new particles is assessed by applicability-domain testing and by independent data sets testing. Understanding of model performance can be done with SHAP values, partial dependence plots and counterfactuals but not toxicological mechanism. Biological interpretation of results can be improved by the use of dissolution, oxidative stress, protein adsorption and cellular Robustness uptake descriptors. Reproducibility pipelines should record software environments, control version, Consistent reporting, model cards, and data-sources. Validating is necessary for assessing safety properly, experiments are, and orthogonal validation is, not computational ranking.

Keywords: Nanotoxicology; R programming; Python; Explainable AI; Quantitative modeling; Reproducibility.

ICEMSET-2026/ST/1347

AI-Guided Nanotherapeutic Target Discovery in Acute Myeloid Leukemia

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Abstract

Acute myeloid leukemia is a dysregulated dedifferentiation and clonal evolution hematological malignancy. The use of molecular oncology, artificial intelligence and nanomedicine can lead to the creation of strategies to exploit specific therapeutic vulnerabilities. This chapter will explore genomic, transcriptomic and proteomic data sources looking at mutations in FLT3, NPM1, IDH1/2, epigenetic regulators and apoptotic pathways. Public leukemia datasets are used to perform preprocessing, subtyping, differential gene expression, pathway analysis and target prioritization. Machine learning techniques can build interpretable models such as calibrated ensemble models to identify reproducible molecular signatures. Virtual screening and molecular dynamics can explore interactions between potential natural compounds and protein targets. However, high docking scores do not indicate that they will be effective in cells, and will not indicate if the target will be engaged and be

selective. Nanotherapeutics were explored including liposomal and polymeric delivery systems, functionalizing with ligands, accounting for pharmacokinetics and hematology including uptake by mononuclear phagocyte system. The benefits of combination therapy and sustained release must be weighed up against marrow penetration, toxicity to the immune system, off-target effects. A validation strategy was developed to look at target engagement in biochemistry, validated leukemia models, healthy hematopoietic cells, patient samples and pharmacodynamics. This chapter outlines how molecular subtyping can be paired with responsible computer modeling and testable nanocarriers to provide evidence-based investigation into precision treatment options in acute myeloid leukemia. Longitudinal samples and single cell reference atlases can help understand if adaptations result from treatment or whether differences reflect molecular subtype. Independent validation is important.

Keywords: Acute myeloid leukemia; Nanotherapeutics; Explainable machine learning; FLT3 signaling; Target prioritization.

ICEMSET-2026/ST/1348

AI-Integrated Quantum Dot Nanobiosensors for Early Oral Cancer Detection

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Abstract

Oral Squamous Cell Carcinomas pose a huge clinical challenge owing to their considerable molecular heterogeneity, late recognition and issues with traditional screening approaches. Saliva provides an easily available source of biological material containing biomolecules including proteins, exosome particles, nucleic acids and inflammatory biomarkers. This chapter will discuss the development of Smart Quantum Dot Nanobiosensors using Artificial Intelligence to detect multiple oral cancer biomarkers. Fluorescent Zinc Oxide and Carbon quantum dots have been explored as potential candidates. They offer tuneable fluorescent properties, surface functionalization and allow antibody, aptamer or oligonucleotide functionalization. This allows detection of biomarkers such as interleukin-8, matrix metalloproteinase-9, CD44 and various microRNAs within saliva. The diagnostic value of these biomarkers needs to be investigated to ensure that they can detect oral cancer, inflammatory and pre-cancerous states. Methods include FRET, fluorophore quenching and ratio analysis. Detection limit, linearity, photostability and matrix effects need investigation. Machine learning techniques can generate predictive models to detect disease-associated biomarkers by analysing spectral data, feature selection, ensemble classification and data calibration. Analytical validation techniques should include blinded samples, independent testing samples, reproducible reference methods and investigation into confounding factors. This chapter will discuss quantum dot toxicity, batch reproducibility, scalability and ease of use at point of care. It will help to identify research needed to produce a reliable saliva biosensor. Future work will help to find if these multiple biomarkers improve sensitivity, specificity, decision making and equitable implementation of the test. These factors are important for evaluating performance and supporting translation into practical clinical applications across different healthcare settings.
Keywords: Oral Squamous Cell Carcinoma; Quantum Dot Nanobiosensors; Salivary Biomarkers; Fluorescence Resonance Energy Transfer (FRET); Machine Learning Algorithms.

ICEMSET-2026/ST/1349

Explainable AI and Network Pharmacology for Ovarian Cancer Pyroptosis

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Abstract

Cell death, immunity and treatment effects are associated with tumour progression in the ovary. Pyroptosis process is context sensitive in these kinds of cycles. Using network pharmacology and explainable artificial

intelligence methodologies, mediators of the pyroptosis-related pathways are understood, including the formation and activation of inflammasome, activation of NLRP3, activation of caspases, cleavage of gasdermins, apoptosis and immune cell infiltration. Quality control, differential expression, survival and pathway analysis are performed using publicly available transcriptomic and proteomic datasets. Networks of multi-target interactions are created for phytochemicals and potential protein targets, and machine learning approach used to identify potential biomarkers. Molecular docking and dynamics are used to investigate protein-interactions, but modulation of pyroptosis cannot be confirmed. Nanotechnology delivery systems examined for improving stability, biodistribution and capture of molecules at cell-specific level. Finally, validation methods rely on certain biomarkers and don't consider necrosis and secondary necrosis to be alternative causes of cell death, contribute to SDG 3-Good Health and Well-being.

Keywords: Ovarian cancer, Pyroptosis, Network pharmacology Explainable AI, Inflammasome, Nanomedicine.

ICEMSET-2026/ST/1350

AI-Based Optical Nanobiosensing for Triple-Negative Breast Cancer

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Abstract

TNBC occurs when cells lack expression of the estrogen receptor, progesterone receptor and HER2. A number of other biomarkers are required to allow for the earlier diagnosis of symptomology. By integrating optical nanobiosensors with stimuli responsive fluorescent materials, plasmonic nanomaterials and machine learning algorithms, there are greater possibilities for sensing disease specific molecular biomarkers. Three sensing platforms discussed in this chapter include surface engineered quantum dots, composite nanomaterials and multiplexed arrays which can target proteins, nucleic acids and inflammatory biomarkers. Sensing mechanisms used for detection include absorption, fluorescence lifetime, scattering, surface interactions and ligand isomerism whilst spectral analysis, normalisation techniques and normalised fluorescence sensing approaches for different modes of detection are also described. Highly predictive diagnosis can be obtained using different machine learning models such as support vector machine, gradient boosted decision trees and regularised logistic regression however various issues have been noted including data leakage, class imbalance and the effect of benign lesions and other cancer types. Design considerations related to analytical and clinical validation requirements including reproducibility, limits of detection, effect of cross reactivity and the use of additional independent patient groups are key factors for successful translation to practice which can be assisted through calibration of the predicted probability values, setting positive and negative thresholds, managing false positive rates and demonstrating clinical utility. Biosafety, biodegradability, sensor stability, interpretability and standardisation are other aspects necessary for accurate TNBC detection.

Keywords: Triple-Negative Breast Cancer (TNBC), Optical Nanobiosensors, Fluorescence-Based Biosensing, Molecular Biomarkers, Quantum Dots, Plasmonic Nanomaterials, Explainable Artificial Intelligence.

ICEMSET-2026/ST/1351

Nanocomposite Membranes for Heavy-Metal Removal and Exposure Reduction

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Abstract

Contamination of toxic metal is still a big threat to potable water, notably in environments where the partial competition of ions interfering and the shifting pH increases limitations for common adsorption-based reduction

techniques. Membranes that use nanocomposite matrix structures are composed of functional polymers, metal oxides, carbonaceous components, and chelating ligands that offers specific separation and selectivity of binding. Diffusivity and the release of secondary pollutants should also be considered. This chapter covers the development of the most promising emerging technologies, electrospinning, phase-inversion and interfacially engineers membranes for the removal of arsenic, cadmium, lead and chromium species and other toxic pollutants, giving details of ion exchange, surface complexation, electrostatic rejection, redox transformation and precipitation, and of the likely significance of speciation and oxidation state; relate functions of membrane separation, adsorption and phase-inversion membranes to pore size distribution, permeant electric surface charge, number of adsorption sites, membrane fouling; describe characterisation of nanoscale performance, electron-microscopy, infrared and X-ray photoelectron spectroscopy, quantification of elemental content, measurement of permeation, flux, permeability and the mass- balance; quantify challenge-water parameters, volumetric flowrates, breakthrough, regeneration, ageing and fouling; derive machine learning models, and identify causes of performance limitation, as well as reasons for experimental variability; investigate the risk of toxic-metal leaching, membrane disposal, toxic-metallaganisation of treated water; relate reductions in exposure to the principle of preventative health. Field trials should address seasonal variability, drinking-water standards and operational practicability, contributing to SDG 6: Clean Water and Sanitation.

Keywords: Nanocomposite membranes; Heavy metals; Metal speciation; Surface complexation; Water quality; Exposure reduction.

ICEMSET-2026/ST/1352

Green-Synthesized Metal Oxide Nanocoatings for Antimicrobial Protection and Public Health

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Abstract

Healthcare associated infection and antimicrobial resistance continue to be a problem in part because microbial biofilms can persist on medical devices, on hospital surfaces and on clinical materials. Green synthesized metal oxide nanomaterials offer a path, for coatings because they bring interfacial reactivity together with less harmful manufacturing. This chapter closely looks at plant mediated synthesis of zinc oxide, titanium dioxide, copper oxide and iron oxide nanoparticles focusing on reduction or complexation nucleation kinetics, surface passivation and batch physicochemical properties. I evaluate the relationships among particle size, crystal structure, defects, surface charge and antimicrobial activity using X ray diffraction, electron microscopy, spectroscopy and surface methods. Proposed methods include changing the membrane releasing metal ions making oxygen species and stopping biofilm from forming, each method matters differently depending on light how it is made, the type of microbe and how long it is used. The coating types like polymer nanocomposites, electrospun nanofibers, sol gel films and layers are compared for durability, adhesion and compatibility with clinical substrates. Using machine learning to design the mix might help connect how it is made and the features of the material, to how it works. Only if there are independently validated datasets and clear mechanistic interpretability. The chapter highlights standardised antimicrobial and standardised biofilm testing, material safety and leaching, as well as resistance testing in repeated exposure. It differs from antimicrobial effectiveness and emphasizes responsible developments of coatings for infection prevention that contain nanomaterials.

Keywords: Green synthesis; Metal oxide nanoparticles; Antimicrobial nanocoating; Biofilm inhibition; Nano-biointerface; Healthcare-associated infections.

ICEMSET-2026/ST/1353

Electrospun PVA Nanofibers for Carcinogenic Water Pollutant Removal

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Abstract

For removal of waterborne carcinogens, sorbents must be highly selective, be able to be reused many times, and must have negligible adverse environmental impact. Due to its water solubility and lack of selectivity towards non-targeted substances, polyvinyl alcohol (PVA) has generally been considered unsuitable for removal of carcinogenic pollutants as sorbent material for removal of carcinogens from water. In this chapter, relationships between PVA fibers' structure and their properties towards removal of aromatic pollutants, heavy metals and disinfection byproducts from Water is described. The chapter starts with a description of how main parameters, i.e. solution rheology, voltage, collector geometry, and post-spinning crosslinking, affect PVA fiber diameter, surface wettability, mechanical strength, and mass transport through fiber sites. To increase removal efficiency of target pollutants, the chapter continues with an in-depth evaluation of chains with Adsorption sites, biochar, metal oxides, and bio-based molecules such as cyclodextrin and chelating agents. Special attention is given to evaluation of permeability retention, possible Chalcogenide Leakages, and associated sorbent mass transport, adsorption, Kinetics and fouling in complex water matrices as opposed to single solute solutions. To further increase removal efficiency, material is optimized using machine learning to find the optimal combination of the a forementioned parameters, to predict removal of multicomponent water pollutant(s), to evaluate and quantify corresponding regeneration performance including related uncertainty. Finally, material(s) are tested for their practical applicability by means of analytical confirmation, assessment of leachate cytotoxicity, assessment of related lifecycle environmental burdens and assessment of related exposure reduction, and PVA-based sorbents are found to be durable, robust, cost-effective, and to be reusable as and for sorbents for many water applications.

Keywords: Electrospinning; Poly(vinyl alcohol); Carcinogenic pollutants; Membrane adsorption; Water remediation ; Exposure prevention.

ICEMSET-2026/ST/1354

AI-Driven Multi-Omics and Quantum Nanobiosensors for Prostate Cancer Detection

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Abstract

Medical diagnosis of prostate cancer is challenging due to the variability. Some cancers, while remaining slower growing, can often become more aggressive types and need timely treatment. However, the current diagnostic modality is PSA testing, which due its lack of specificity can make it difficult to know if there is any medically important cancer present. For this reason, research has sought in recent years to utilise molecular and new sensor technology to aid with diagnosis. The major issues facing prostate cancer diagnosis are that they can often be variable in their biological nature. Some will remain fairly slowly growing however others can often become an aggressive type. While PSA can currently be used for initial evaluation, they suffer from a lack of specificity. To overcome this issue, various researches have looked into using molecular signatures along with new sensors to aid with di-agnosis. Quantum Enabled Sensor Technology are now becoming quite popular options to look into when diagnosing. These include quantum dots, florescence, Forster Resonance Energy Transfer, aptamers and nano particulate electrochemistry. While these techniques offer some exciting ideas, challenges still need to be overcome to provide usefulness. Stability under illumination, functionality, selectivity and consistency within

the biological matrix need to be ensured. When designing computer modelling a validation of real data from patients, correct parameterisation and clinically relevant cut-off points need to be determined.

Keywords: Prostate cancer; Quantum-dot biosensors; Multi-omics; Explainable AI; PSMA; Diagnostic validation.

ICEMSET-2026/ST/1355

Optimized Nanofibre Biosensors for Pancreatic Cancer Biomarkers detection

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Abstract
Since pancreatic ductal adenocarcinoma (PDAC) is largely diagnosed at advanced stage, this drives the search for accessible biomarker panels and sensitive detection interfaces. Molecular recognition on nanofibers prepared by electrospinning creates materials with high surface area for capture, but clinical value requires careful consideration of materials performance and biomarker specificity. This chapter surveys electrospun nanofibers of polymers or composites for optical, electrochemical, and combined-signal sensing of pancreatic cancers targets. Candidate analytes include cancer antigen 19-9 (CA19-9), EV proteins, circulating nucleic acids, and blood-borne inflammatory signatures, against a background of imperfect specificity, variable sensitivity by stage, and differing contributions from cancer as compared with chronic pancreatitis and biliary obstruction. Fiber diameter, fiber-matrix porosity, surface hydrophobicity, mechanical properties, surface functional groups, and receptor orientations are considered as factors influencing the sensor response. Surface modification with inorganic nanostructures or nanocarbon, or integration of fluorescent probes, may be used to improve the signal transduction and analyte accessibility. Computational approaches may help to denoise, unmix spectral images, compensate drift, and interpret multimodal signals while addressing potential source leakage at device and patient levels. Performance estimates should include limits of detection, limits of quantitation, intra- and inter-assay precision, spike recovery, matrix effects, and potential nonspecific stimuli such as inflammation or stool pigments. Its clinical interpretation requires independent sample sets, validated comparator tests, and predicting positive and negative predictive values at realistic disease rates. A proposed workflow from characterization through clinical verification minimizes the uncertainties to which PDAC detection is susceptible. Sample collection and testing integrity is of special concern for early-stage PDAC detection. Material performance should be reported for independent fabricated sensor units.

Keywords: Pancreatic cancer, Electrospun nanofibers, CA19-9, Nanobiosensors, Machine learning, Analytical specificity.

ICEMSET-2026/ST/1356

AI-Driven Digital Twin and Nano Sensor Integration for Smart Structural Health Monitoring and Predictive Maintenance of Sustainable Infrastructure

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Abstract
The fast advancement in the field of smart technologies has provided new possibilities to enhance the safety, durability, and sustainability of civil infrastructure. Traditional structural health monitoring techniques usually rely on inspection at regular intervals and use conventional sensors that might not give real-time information about the state of the structure. This study aims to develop a framework that will integrate Artificial Intelligence (AI), Digital Twin technology, and Nano Sensor systems for smart Structural Health Monitoring (SHM). The swift advancement of smart technology has led to the creation of new opportunities. In the proposed

methodology, advanced nano sensors are used for gathering information regarding strain, stress, vibration, temperature, crack formation and corrosion in the structure. The gathered information is sent to a digital twin platform enabled by AI, where machine learning algorithms analyze the behavior of the structure, detect abnormal conditions and predict any deterioration in the future. The digital twin is a virtual model of the actual infrastructure that can be updated using information from the sensors. The proposed methodology will not only prevent structural failures, minimize maintenance costs and increase the reliability of the infrastructure but also ensure that the infrastructure serves for a longer period of time. The proposed methodology is sustainable as it encourages regular maintenance and proper use of resources and prevents wastage of materials.

Keywords: Artificial Intelligence, Digital Twin, Nano Sensors, Structural Health Monitoring, Predictive Maintenance, Sustainable Infrastructure, Machine Learning.

ICEMSET-2026/ST/1357

ETIPOS: Encrypted Tunnels in Phones Obviously Secured

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Abstract

ETIPOS is a heavily security focused file transfer system designed to transfer files wirelessly between mobile devices through a laptop that acts as a gateway. The system establishes local communication using Wi-Fi, which allows users to transfer files without relying on external cloud-based services since relying on them for file transfers can result in excessive resource consumption and potential privacy issues. Therefore, we aim to create a locally hosted solution which can be a more efficient and secure option. A laptop-hosted web interface, accessible through HTTPS and a QR-code-based connectivity, enables convenient file exchange. To enhance security, ETIPOS uses Magika for file type identification, ClamAV for malware scanning, heuristic analysis and local LLM-based threat assessment via Ollama. The files are tested for any potentially malicious characteristics before transfer where the analysis is performed locally to enhance privacy, reduce reliance on third-party services and add another layer of protection during wireless file sharing.

Keywords: Secure File Transfer; Wireless Communication; Local Network Security; Malware Detection; Artificial Intelligence; Privacy-Preserving File Sharing; Local Gateway.

ICEMSET-2026/ST/1358

Synergistic effect of redox additive electrolyte on the electrochemical performance of $ZnCo_2O_4$ cathode for advanced supercapacitors

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Abstract

Growing energy consumption, demands renewable energy sources and energy storage devices. Supercapacitor plays a crucial role in this pursuit. In this study, binder free spinel structure of zinc manganite ($ZnCo_2O_4$) nanoflowers was directly grown on nickel foam via an eco-friendly hydrothermal route. A calcination treatment was provided after hydrothermal synthesis to enhance its electrochemical performance and its crystallinity. The investigation of electrochemical performance of the spinel $ZnCo_2O_4$/NF structure, by cyclic voltammetry (at different scan rates) and galvanostatic charge–discharge (at different current densities) and electrochemical impedance spectroscopy techniques using a 3 M KOH and 0.1 M LiF redox additive plus 3 M KOH electrolyte separately. A specific capacitance value of 3168 F g^{-1} and 3123 F g^{-1} with a scan rate of 5 mV/sec CV and a current density of 5 A g^{-1} GCD, respectively, was exhibited by the synthesized $ZnCo_2O_4$/NF nanostructure in 0.1 M LiF + 3 M KOH electrolyte. Spinel structure of $ZnCo_2O_4$/NF electrode facilitates excellent charge storage capability, which can be attributed to the synergistic effect of the porous nickel foam substrate, extra redox additive ions in electrolyte and redox active $ZnCo_2O_4$ nanostructures, which facilitate multiple oxidation states

and efficient electron transport. These results demonstrate that the hydrothermally synthesized $ZnCo_2O_4$/NF is a promising electrode material for electrochemical energy storage and supercapacitor applications.

Keywords: Supercapacitor, redox additive, specific capacitance.

ICEMSET-2026/ST/1359

Hydrothermally engineered $ZnCo_2O_4$ anode material for microbial fuel cell application

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Abstract

Enhanced electrode activity and longevity is needed for the development of microbial fuel cell (MFC) innovation. This study examines the development and upgrade of a single chamber soil based compost microbial fuel cell (MFC) using $ZnCo_2O_4$ coated copper electrode. Electrode material were fabricated via hydrothermal process and their electrochemical properties were examined through cyclic voltammetry (CV), linear sweep voltammetry (LSV), electrochemical impedance spectroscopy (EIS), Power density measurements revealed significant increases, reaching 3.04 mW/cm² for Zn Co_2O_4 coatings—approximately 9-fold higher than un-coated electrode in the microbial fuel cell. Structural and surface morphology analyses were analysed using energy dispersive X-ray spectroscopy with scanning electron microscope (EDAX-SEM) and X-ray diffraction (XRD)

Keywords: $ZnCo_2O_4$, MFC, power density.

ICEMSET-2026/ST/1360

Carbon Quantum Dot–Graphene Hybrids for Liquid Biopsy Biomarkers

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Abstract

With the aim of offering a non-invasive approach to understand tumor-related molecular signals, liquid biopsy presents a number of challenges including the low concentration, complexity and interference associated with detecting these molecules. Carbon quantum dot-graphene hybrids allow fluorescent nanomaterials to be combined with conductive or highly quenching 2D materials to form tunable optoelectrochemical sensing platforms. This chapter will describe the physics and chemistry principles behind how surface properties of carbon dots, oxidation of the graphene, electron transfer, fluorescence resonance and ligands affect the performance of the sensor. Circulating tumor markers including cell free nucleic acids, extracellular vesicles, tumor associated proteins and specific metabolites will be discussed to determine if they are suitable for detection. Methods to produce and functionalize the hybrid will be described to determine the dispersibility, consistency, non-specific binding and compatibility with complex plasma/serum samples. Fluorescent recovery, ratiometric and time resolved fluorescence techniques will be discussed alongside charge transfer resistance and signal amplification to improve electrochemical sensing. Blind testing, standardisation, correct calibration of the sensor (same matrix), limit of blank, detection limit and correct target will be crucial. Machine learning can be used to merge sensor data together however it is important to make sure there is no leakage within the models and account for inflammation or benign conditions. Critical discussion around the scalability of production, consistency of the material, biocompability and validation with independent patient cohorts. This chapter will demonstrate the importance of understanding material properties and ensuring the interface physics are present to give reliable biomarkers. Future work should demonstrate independent validation, utility within the clinic, good uncertainty reporting, robust biology controls, good reference material and consideration of biosafety. Testing with realistic samples, robust benchmarking and stable signals.

Keywords: Carbon quantum dots; Graphene; Liquid biopsy; Fluorescence quenching; Circulating biomarkers; Nano-biointerfaces.

ICEMSET-2026/ST/1361

Intelligent Nanotechnology for Next-Generation Healthcare

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Abstract

Almost all the screening and early detection panels of the biomarkers will be multiplexed, signals alone will be below limit of quantification noisy heterogeneous but with identification, in current arrays of nanobiosensors can be integrably embedded in hand-held, on-chip, analyzers with a few confounder channels to interpret crosstalks, correlated errors and other drifts with operationally feasible deployment and analysis algorithms. We first considered detection of a protein, nucleic acid, metabolites and inflammatory biomarkers by nanomaterials, listed as capture chemistry, array design, optical/electrochemical readout, sample preparation with microfluidics and secondly, extraction of features (characterizing different states of the disease) and the use of information-boosted and statistically robust classifiers to infer and validate clinical diagnosis including feature engineering, standardization, probability calibration, keeping train/test separation at the patient level, external validation in multi-center clinical studies, nested cross-validation, class imbalance, missing data, calibration, false positive, sensitivity, specificity and comparison to reference test. The description of analytic and clinical sensitivity, limit of detection, traceability, precision, carryover, instrument-to-instrument variation, hemolysis and storage effect, robustness at the point-of-care especially explaining techniques (including causal diagram) that can be helpful for (a) identify potentially causally-related channels that are directly related to etiology (b) objectively design-randomized (with negligible, unbiased bias) solid reference test for standardization of calibrators. Our empiric pipeline can be expected to shepherd the design of screening systems validated by pre-specified prospective clinical validation studies, including independent analyte validation, clinical utility, uncertainty analysis, biological controls, comparator method, absolute-integrated nanomaterial design and development from engineering to epidemiology to clinical validation and supports SDG 3 (Good health and well-being).

Keywords: Multiplex nanobiosensors; Cancer screening; Explainable AI; Biomarker panels; External validation; Diagnostic calibration.

ICEMSET-2026/ST/1362

Integrative Bioinformatics and Molecular Docking of Natural Therapeutics in Cervical Cancer

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Abstract

Cervical cancer is a complex disease that, despite recent advances in prevention, is largely caused by persistent infection from high-risk human papillomavirus (HPV). Natural products show great promise as a chemically diverse source of anti-cancer agents. This chapter aimed to use multiple bioinformatics tools to provide information about biology involved in cervical cancer. By using bioinformatics information from both viral oncogens and host epigenetics, transcriptomics, and therapeutic targets, a methodology has been developed to understand how the HPV E6/E7 oncoproteins cause disruption to p53, retinoblastoma networks, cell cycle regulation, DNA damage responses, and inflammation. Tumor and normal data was extracted from publicly available databases. Quality control, batch correction, differential gene expression, pathway analysis, and network analysis was completed. Molecular targets were identified using network pharmacology. Molecular

docking and dynamics were used to study the interactions between the selected phytochemicals and molecular targets. Without experimental validation, biochemical methods were required to identify which phytochemicals could be used as leads. Biodegradable polymers and lipid-based nanoparticle delivery systems were considered. Using cervical cancer cell lines expressing HPV positive and negative along with non-malignant cervical cells, an experimental approach was proposed to validate the phytochemicals. Differences in HPV genotypes, tumor heterogeneity, reproducibility, and translation to humans were taken into consideration, including differences between HPV and HPV cancers. It is important to validate experimental approaches and consider pharmacology in human tissues to help develop phytochemical-based nano-drugs to treat cervical cancer.

Keywords: Cervical cancer, HPV oncogenesis, phytochemicals, integrative bioinformatics, molecular dynamics, nanocarriers.

ICEMSET-2026/ST/1363

Quantum Dot-Enhanced LAMP Biosensors for Rapid Salmonella Detection

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Abstract

A fast detection of Salmonella in clinical, food and water samples is required to manage and monitor infection. Molecular techniques may require an infrastructure which may not be available at point-of-care. Loop mediated isothermal amplification (LAMP) allows for nucleic acid amplification at a constant temperature. Quantum dot fluorescence offers the opportunity for signal amplification and a variety of readouts. The integration of LAMP and nanobiosensors is discussed throughout this chapter. This will include target choice, primers, amplicon kinetics, fluorescent nanoparticle conjugates and signal enhancement or reduction. Non-specific amplification, contamination, inhibition, background fluorescence and nanoparticle aggregation are issues that may arise causing assays to need to have strict controls including extraction controls, negative controls, off targets and verification with a known method. Assay performance such as limit of detection, time to result, exclusivity/inclusivity, repeatability and recovery should also be considered. Fluorescent data can be easily quantified using smartphone imaging and machine learning. However, training and test sets must be done using independent assays and samples. Considerations for the practicality of an assay such as portability, closed assays, stability and quality assurance without manual involvement will be discussed. A validation-based approach was used in this chapter to understand how quantum dot enhanced Salmonella diagnostics. It is important to note that increasing fluorescence using nanoparticles does not necessarily improve sensitivity and specificity. Future work must include independent analysis validation, prospective utility, clarity of uncertainty, good biological controls, verified reference material, careful risk assessment, realistic samples and understanding of mechanism as well as good repeatability between batches for use in the clinic.

Keywords: Salmonella; LAMP; Quantum dots; Fluorescence biosensing; Isothermal amplification; Point-of-care diagnostics.

ICEMSET-2026/ST/1364

Sustainable Synthesis of CuO Nanoparticles: Structural, Optical, and Photocatalytic Properties for Water Remediation

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Abstract

Copper oxide (CuO) nanoparticles were synthesized through an environmentally friendly method using a natural extract as a reducing and stabilizing agent. The structural, morphological, and optical properties of the synthesized nanoparticles were investigated using different characterization techniques, including X-ray

diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), UV–Vis spectroscopy, photoluminescence (PL), and scanning electron microscopy (SEM). The results confirmed the formation of crystalline CuO nanoparticles with characteristic optical properties and structural defects that may influence their photocatalytic behavior. The photocatalytic performance was evaluated through the degradation of different organic dyes under UV irradiation. The synthesized nanoparticles exhibited promising photocatalytic activity, demonstrating their potential for the removal of organic pollutants from aqueous solutions. These findings highlight the advantages of green synthesis as a sustainable approach for producing semiconductor nanomaterials with potential applications in environmental remediation and wastewater treatment.

Keywords: Copper oxide; Green synthesis; Optical properties; Photocatalysis; Water treatment.

ICEMSET-2026/ST/1365

Role of Betaine in Natural Deep Eutectic Solvent Development

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Abstract

Several organic molecules from biological systems have been identified as playing a significant role in green chemistry. These molecules are used for stereospecific transformations and for preparing solvents for various applications. Among these molecules, a naturally occurring, stable, zwitterionic, low-molecular-weight compound betaine has the potential to form a link with several HBDs. Although it is primarily used in health treatment or nutraceuticals, its potential in green chemistry is highly relevant. DES prepared with betaine can be used for biodiesel purification, enzyme stabilisation, CO_2 capture, electrochemistry, and food packaging film formulation. This paper discusses various methods for synthesizing DES using betaine and its limitations such as high viscosity, heat sensitivity, and emulsion formation in developing lab-to-industrial-level applications. In conclusion, next-generation betaine-based DES may be combined with a third component or other technology, or integrated with AI-based customisation, to make it a suitable candidate for a sustainable green solvent.

Keywords: betaine, NDES, Green chemistry, Biodiesel.

ICEMSET-2026/ST/1366

Nanoengineered Tablets for Effective Water Decontamination

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Abstract

Water pollution caused by industrial effluents, domestic wastewater, dyes, heavy metals and other harmful contaminants has become a major environmental concern. The present study focuses on the development of nanoengineered multifunctional tablets for effective water decontamination. These tablets are designed by incorporating iron oxide (Fe_3O_4) nanoparticles with selected chemical agents and binding materials to enhance the removal of various water pollutants. The iron oxide nanoparticles act as effective adsorbents due to their high surface area and adsorption properties, helping to remove heavy metals and other dissolved impurities. Additionally, selected oxidizing and disinfecting agents contribute to the degradation of organic pollutants and the reduction of microbial contamination. The tablets are prepared through a controlled mixing, grinding and compression process to obtain a convenient solid formulation. Their performance is evaluated by monitoring important water quality parameters, including Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Total Dissolved Solids (TDS) and pH. The developed system offers a simple, portable and potentially cost-effective approach to wastewater treatment. This research aims to explore the potential of nanoengineered tablets as an alternative treatment approach for industrial, domestic and rural areas wastewater management, with scope for further optimization, reuse studies and practical applications.

Keywords: Nanoengineered tablets, Fe_3O_4 nanoparticles, water decontamination, wastewater treatment, adsorption, COD, BOD, TDS.

ICEMSET-2026/ST/1367

Design and Development of a Low-Cost IoT-Enabled Smart Insole for Real-Time Plantar Pressure Monitoring

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Abstract

Continuous plantar pressure monitoring is important for early diagnosis of diabetic foot complications, gait abnormalities, rehabilitation assessment and sports biomechanics. However, commercial plantar pressure measurement systems are usually expensive, bulky and limited to clinical environment, which prevents their widespread use for continuous remote healthcare. This paper discusses the design and development of a low-cost Internet of Things (IoT) enabled smart insole for real-time plantar pressure monitoring using Force Sensitive Resistor (FSR) sensors. The proposed system is composed of several FSR sensors at anatomically relevant sites of the insole, signal conditioning circuits, ADS1115 high-resolution analog-to-digital converters and an ESP32 microcontroller for efficiently acquire and wirelessly communicate the data. The acquired plantar pressure data are transmitted through Wi-Fi to the ThingSpeak cloud platform allowing real-time visualisation, remote monitoring and long-term data storage through a web-based interface. A modular architecture was implemented and experimentally validated in configurations with single, three, six and eight sensors to assess scalability and measurement reliability. The experimental results demonstrate stable pressure acquisition, reliable wireless data transmission, and continuous tracking in the cloud under static and dynamic loading conditions. The proposed smart insole offers a low-cost, portable and scalable wearable plantar pressure monitoring solution which can be applied to diabetic foot management, gait analysis, rehabilitation and remote healthcare. Moreover, the modular design offers a flexible platform for future integration of machine learning algorithms, high-density pressure mapping and personalised healthcare analytics.

Keywords: Plantar pressure monitoring, smart insole, Internet of Things (IoT), FSR, ESP32, wearable sensors, gait analysis, diabetic foot and real-time monitoring.

ICEMSET-2026/ST/1368

V_2C-MoS_2 Hybrid for Supercapacitor Applications

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Abstract

Over 80% of global energy use relies on fossil fuel sources, with the fast-growing global population and urbanization leading to increasing energy demands. Supercapacitors have received considerable attention lately due to their high energy storage capacity, quick charging-discharging rates, and long cycle life despite their relatively lower energy density compared to batteries. It is thus important to develop novel electrode materials to improve the energy storage properties of supercapacitors. In this regard, MXenes have become promising due to their layered structure, high electrical conductivity, and electrochemical behavior. This work focuses on the synthesis, structural characterization, and electrochemical behavior of a V_2C-MoS_2 hybrid electrode material for supercapacitor applications. The prepared material was characterized by XRD, FTIR, Raman Spectroscopy, FESEM, XPS, and HRTEM. Electrochemical properties were measured using a three-electrode system, including cyclic voltammetry, galvanostatic charging and discharging, and cycling stability analysis.

Keywords: MXene, Vanadium carbide, Molybdenum disulfide, Energy storage, Supercapacitor; MXene–MoS_2 Hybrid; Hybrid electrode.

ICEMSET-2026/ST/1369

Investigation of Shear Adhesive Strength of Unidirectional UHMWPE Fibre Sheets Using LDPE-Based Interlayers and Nanofillers

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Abstract

The Utra-high-molecular-weight polyethylene (UHMWPE) fibres are one of the most commonly used high performance fibre for the ballistic application. However, the poor interfacial adhesion between UHMWPE fibre sheets restricts the proper consolidation of laminate and ballistic performance. This study compares the single-lap-shear strength of UHMWPE UD sheets bonded without additional resin, with low-density polyethylene (LDPE) interlayers containing nanoclay, graphene nanoplatelets (GNP; 0.5, 1.0 and 1.5 wt%) and carbon nanotubes (CNT). The Shear adhesive strength was investigated as per the ASTM standard D5868. The Shear adhesive strength of neat UHMWPE fibre joints reached 0.86 MPa and nanoclay–LDPE joints 0.73 MPa. CNT-bonded joints showed low, scattered strength (0.11–0.55 MPa). Shear strength increased with GNP content in LDPE resin, reaching 1.94–2.48 MPa at 1.5 wt% with sustained load retention. GNP–LDPE is therefore indicating its potential as an interlayer for UHMWPE-based ballistic laminates.

Keywords: UHMWPE; UD fibre sheet; single-lap shear; graphene nanoplatelets; interfacial adhesion; ballistic composites.

ICEMSET-2026/ST/1370

Comparative Evaluation of Sonication-Assisted Versus Hydrothermally Engineered $Nb_2C/NiCo_2O_4$ Nanocomposites for High-Performance Supercapacitor Electrodes

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Abstract

To mitigate the persistent energy-power density trade-off in supercapacitors, advanced electrode materials must integrate high electrical conductivity with fast, accessible redox kinetics. Herein, we present a comparative investigation of Nb2C/NiCo2O4 (NCN) nanocomposites synthesized via two distinct paradigms: a rapid, room-temperature sonication-assisted approach (3h) designed to suppress MXene (Nb_2C) restacking, and a conventional hydrothermally engineered route (120-200 C, 6-12h) optimized for hierarchical 3D morphology formation. Comprehensive structural and spectroscopic characterization (XRD, Raman, FTIR, and XPS) confirm the preservation of the Nb_2C (002) framework alongside characteristic spinel $NiCo_2O_4$, vibrational modes and strong interfacial bonding interactions. BET surface area and morphological analyses demonstrate that the hydrothermal route yields an optimized mesoporous 3D nanoflower architecture, whereas the sonication method provides a homogeneous nanoparticle dispersion. Electrochemical evaluation in a 3M KOH electrolyte under a three-electrode configuration reveals distinct performance metrics: the hydrothermally synthesized composite achieves a maximum specific capacitance of 2101 F/g at 3A/g with an energy density of 47 Wh/kg (~90% retention over cycling), while the sonication-assisted electrode demonstrates exceptional cycling stability (96.1% retention after 5000 cycles) and specific capacitance of 1312 F/g at 3 A/g.Trasatti and Cottrell kinetic analyses elucidate mixed capacitive-diffusion-controlled charge storage mechanisms across both platforms. This comparative study highlights the critical structure-property-synthesis relationships necessary for tailoring scalable, high-performance MXene-transition metal oxide hybrid electrodes for next-generation energy storage.