INDIAN NATIONAL ACADEMY OF ENGINEERING

E-Newsletter

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INAE VISION 2020-2025

INAE VISION

To be the premier Engineering Academy of the World providing timely inputs to the national and international policy makers, and to extend appropriate assistance in developing engineered solutions for the challenging problems facing contemporary societies and the humanity as a whole.

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INAE Mission

To serve professionals in building and institutionalizing engineering and technological excellence in education, research and industry in India and support advancement of engineering profession globally

Technology Roadmap

We are living in exciting times. We will have to contend with the profound transformation of our society and our industry, because of two revolutions in the making – namely, the digital revolution and the impending transition to fossil fuel free energy globally.

The digital revolution is rapidly transforming the very nature of industrial enterprise today. Many disruptive transformations are maturing rapidly because of the advent of cloud computing and internet of things (IoT) and due to major advances and breakthroughs being made on several fronts such as artificial intelligence (AI) including machine learning (ML) and big data analytics, robotics, autonomy, drones, 3D printing, advance sensors and 5G technologies.

Another revolution in the making is the exciting possibility of fossil fuel-free generation of electricity in the coming decade. The availability of electricity based on renewable sources such as sun, wind and biomass, will cause a major disruption as well as an opportunity for creating a cleaner world, since use of fossil fuels (coal, oil or natural gas) currently, creates deleterious environmental consequences which need urgent attention.

While both these revolutions will cause major disruptions in how we live and work, the transition to the new world in the making is contingent upon the availability of new sources of critical raw materials.

Both digital hardware and generation of electricity from renewables (including the technological challenges associated with energy storage) require a host of new metals and materials for which the new value chains (also the appropriate global supply chains) will have to be established. Innovative processes for extraction of minerals and metals as well as recycling, which are more energy efficient and environment-friendly will have to be developed to produce these critical elements.

To facilitate this global transition, we need to create human resources with high level of domain expertise in different facets of engineering as well as the much needed engineering skill sets needed to deal with the problems of scalability, uncertainty, reliability, complexity, system engineering, ability to deal with variability and yet manufacture products and create solutions of uniform and reproducible quality, capability to design, develop and optimize engineering systems for a given set of inputs and for a desirable set of assured outputs of consistent quality.

Our engineering education has to be appropriately re-engineered so as to equip our future leaders with not only the domain expertise but also the skillsets to innovate continuously and consistently in the face of constant change and dynamic transformations. The human ingenuity and the preparing the well-trained minds, will be critical ingredients in responding to the challenges ahead.

It in this context, INAE has come up with the following areas for our focused attention in the next five years. We believe that these efforts will assist us in facilitating the smooth transition to the new world in the making.

1. **Accelerated Discovery, Development and Deployment of Novel Materials, particularly for strategic sectors like Defense, Atomic Energy and Space.**

We have an urgent need of materials (metals, alloys as well as composites) development for the following sectors – auto sector (both electric vehicles as well as IC engines based vehicles), aerospace, ultra-supercritical power plants, nuclear power plants, renewable energy sector (novel PV materials, rare earth magnets, battery materials for both large scale energy storage as well as for electric vehicles and other electronic appliances, thermoelectric materials for converting low temperature heat into electricity), novel sensors for healthcare industry, materials for the defense applications and space applications, to name a few.

These materials will have to engineered for India-specific applications. That means one must consider during the process of design & development itself, the kind of natural resources we have and the kind of supply chains we will be able to establish to source the starting raw materials, considering the complex geo-political scenario and vulnerabilities associated with dependence on raw materials from abroad.

The other important consideration is the speed of development. In order to remain globally competitive in this domain, we must leverage the state of the art digital platforms (equipped with advance modeling, simulation, data analytics and knowledge engineering tools) for accelerating the development cycle from conception to deployment in actual applications as well as the entire life cycle (cradle to cradle or cradle to grave in some cases), that is, even for the structural health monitoring of the structures where these materials will be deployed.

Another important consideration is the environmental impact of these materials, that is, we must undertake a life cycle analysis, both with respect to the environmental footprint as well as the energy efficiency (actual consumption as compared to the thermodynamic energy needed to accomplish the particular task), for every developmental effort.

It is now well established that integrated computational materials engineering (ICME) approach can help accelerate the materials development cycle.

INAE will work towards coming up with a national strategy to establish and institutionalize the ICME based approach for all material development efforts. The digital platform, thus created, must be equipped with knowledge engineering capabilities so that it can not only act as a knowledge repository of all past efforts made thus far but also continues to update the knowledge going forward.

2. **Strategies for Energy Transition to Fossil Fuels free Renewable Energy Sources**

It is inevitable that India, like several other nations of the world, will move away from fossil fuels as a source of energy. While we have made some headway in developing renewable energy sources like solar and wind, the necessary infrastructure to support the energy transition does not exist at the present time.

INAE plans to create an interdisciplinary expert group to study the whole energy transition comprehensively and holistically, keeping in mind the challenges inherent in such a massive transformation.

INAE will focus on the following important sectors which will be disrupted in the immediate future and/or the areas of concern which we require a strategy for, urgently to facilitate the transition

- Large scale energy storage solutions - Solutions other than Lithium Ion Batteries which do not seem to be appropriate for a country like India for a variety of reasons including the fact that we do not have the basic raw materials - Liquid Metal Flow batteries (for example, Vanadium Flow Batteries) is another attractive option which must be explored.
- Electricity Grid Infrastructure - current grid will not be able to cater to intermittent and distributed electricity inputs; the concept of smart grids which is adequately robust to cater to both supply side challenges (renewable energy sources) as well as demand management (dynamic pricing to take care of its peak loads).
- Transportation (electric mobility, both for people as well as for goods).
- Mining, Mineral Processing and Extractive Metallurgy Industry (which currently depends totally on fossil fuels not only as a source of heat but also as a reductant to convert metal oxides to metals).
- Recycling of waste by-products including municipal waste, tailings and smelter slags including steel slag, red mud and spent pot lining, electronic waste and hospital waste.
- Supply chains for raw materials needed for the transition - sourcing strategies from other geographies, urban mining, deep sea mining and space mining.
- Finding alternative technology options for the manufacture of steel and cement to reduce the environmental foot-print - currently these two materials which will continue to remain the backbone of the Indian economy for the foreseeable future and the consumption is likely to increase by an order of magnitude in the coming decade.
- Waste-water treatment and recycling.
- Water purification technologies including desalination

3. Excellence in Engineering Education

Several groups including other academies globally, are working on the new curricula for engineering education so that our young emerging leaders are adequately equipped with necessary engineering skill sets to face the challenges in the coming decades.

Various deliberations within India as well as abroad have emphasised the need of providing hands-on design experience, problem solving skills and exposure to the systems engineering concepts, tools and technologies to the engineering students. The curricula also need to be updated with the advancements in digital technologies.

All engineers must be familiar with the sustainability paradigm and must be able to do life cycle analysis for every engineering product. They must be equipped with knowledge and the experience with various digital platforms and modelling tools such as computational materials engineering (all the way from atomistic scale to macroscopic scale), computational fluid dynamics, structural analysis tools, life cycle analysis modelling tools, engineering scale up, robust design methodologies to take care of uncertainty and complexity, machine learning and data analytics tools and algorithms, multi-objective and multi-variate optimization tools and technologies.

It is important that the professional ethics is part of the engineering course curricula. A multi-disciplinary systems perspective to all engineers will certainly broaden their horizons – much needed to face the emerging world scenario. Good communication skills and ability to work in teams, are also prerequisites for engineers to succeed in the real life.

All engineers must possess basic IT skillsets and it is a given since digital technologies are transforming every aspect of our lives.

A multidisciplinary INAE Expert Group will critically examine the current status of engineering education, identify gap areas and strive to fill those gaps with appropriate action plans

4. World Class Infrastructure

INAE will come up with an action plan in consultation with all stake- holders to upgrade our national infrastructure within next few years. This will include

- Requirements, technology options and the investments needed to create a few smart cities in the country - including mobility, healthcare facilities, e-governance, access to affordable housing, utilities (electricity and water), waste collection, processing and recycle, education, communication, maintenance of infrastructural facilities, disaster management infrastructure including extreme events (for example, excessive rain and floods) etc.
- Requirements, technology options and the investments needed to create a rural infrastructure so that they can enjoy access to certain basic amenities where they are located - digital connectivity for example can provide them with access to healthcare, online education, information dissemination, financial inclusion, logistics warehousing and agriculture and farm productivity with engineering focus etc.

5. Cyber-physical Systems

Globally innovations are taking place at the interface of digital technologies and domain expertise. For example, manufacturing is being transformed as a consequence of the following - robotics and automation, Internet of Things (IoT), cloud computing, 3D printing, AI, machine learning and data analytics (Digital Twins), structural health monitoring of built structures and engineered products, drones, autonomy, data analytics based predictive asset maintenance systems, blockchain technology to facilitate complete traceability of the products, digital platforms for integrated design, development, deployment and monitoring of materials and products and knowledge engineering platforms for capturing, retaining and context sensitive retrieval of knowledge to solve challenging problems.

Similarly leveraging the advanced digital technologies, the infrastructure available in a given locality or a city can be upgraded for easy accessibility – for example, healthcare facilities, e-governance, utilities (electricity and water)

It is now possible to make most of healthcare facilities available to the citizens at their place ofresidence (particularly important for senior citizens living alone) through the intervention of digital connectivity, sensors and IoT solutions. Provision of healthcare and affordable Medicare facilities through technological interventions is a key focus area.

INAE will select certain areas for focussed attention during the next five years and develop strategies to create infrastructure to facilitate digital transformation for achieving a set of desirable objectives for example, higher productivity, higher efficiency, better quality of life and better quality of products, reduced cost of services, higher safety of workers, etc.

Back to Main Page

ACADEMY ACTIVITIES

Academy News (Covering period from October 2025 to December 2025)

Joint activities with SERB (now ANRF) – INAE

I. Erstwhile SERB (now ANRF) – INAE Online and Digital Gaming Research Initiative

INAE is implementing the erstwhile SERB (now ANRF) –INAE Online and Digital Gaming Research Initiative with the objective of promoting digital gaming research and strengthening India's self-reliance in advanced Augmented Reality (AR) and Virtual Reality (VR) technologies. As digital gaming represents a relatively new area of research and development in the country, a pre-conclave and conclave were organized, following which a call for proposals was launched under three categories:

- Category I: R&D in Learning, Educational, and Leisure Online Gaming Platforms
- Category II: Immersive Game Prototypes, with a focus on Indian Culture & Values
- Category III: Collaborative Technical Design Process- Creation of SERB Game Labs

An initial allocation of ₹25 Crore (recurring and non-recurring) was received from erstwhile SERB. Subsequently, in May 2024, the G-Hub project under Category III was withdrawn by ANRF and currently, 11 projects under Categories I and II are in progress.

Project monitoring and review are carried out by the Program Management and Advisory Committee (PMAC), constituted to evaluate, select, and oversee the funded projects. PMAC review meetings are conducted on a biannual basis, during which Principal Investigators, Co-Principal Investigators, and industry partners present progress updates and demonstrate the games developed. To date, four review meetings have been conducted—two online in March 2024 and April 2025 and two in-person in November 2024 and 2025. Based on PMAC recommendations, second-year funding has been disbursed for the projects.

II. INAE - SERB (now ANRF) Abdul Kalam Technology Innovation National Fellowship

Launched in 2017, the fellowship supported translational research by engineering professionals in publicly funded institutions, with an emphasis on deployable and commercializable technologies rather than academic credentials. In March 2024, erstwhile SERB announced that the scheme was halted due to the transition to ANRF, with no new nominations or extensions permitted. Since its inception, 57 fellows were conferred, leading to 115 patent filings, multiple technology ventures, and 374 high-impact publications, making it a landmark initiative in advancing translational research and innovation in India.

The details of the 10 ongoing fellowships, covering the tenure from 1 October 2023 to 30 September 2026, are provided below:

1. **Dr Chetan Singh Thakur, Associate Professor, Indian Institute of Science Bangalore**, conferred for his proposal on "Minimally Invasive Real-Time BCI System for Motor Neurorehabilitation Using Machine Learning Co-Processor Chip".

2. **Dr Hardik J. Pandya, Associate Professor, Department of Electronic Systems Engineering, Indian Institute of Science, Bangalore** conferred for his proposal on "Neonatal Hearing Screening System Development and Validation".

3. **Mr Sarath S Nair, Engineer F, Biomedical Technology Wing, Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Thiruvananthapuram, Kerala,** conferred for his proposal on "Transcutaneous Energy Transfer System for Implantable Medical Devices".

4. **Dr. Tapan Kumar Gandhi, Associate Professor, Dept. of Electrical Engineering, IIT Delhi** conferred for his proposal on "AI powered Virtual Reality device for fast and accurate diagnosis of visual field defects and impairment in 3D Motion perception".

5. **Prof Sukumar Mishra, Professor (HAG), Department of Electrical Engineering, Indian Institute of Technology Delhi** conferred for his proposal on "Electric Vehicle (EV) agnostic, solar photovoltaic (PV) supportive, cyber secured, bidirectional, single gun charger".

6. **Prof Swati Neogi, Professor, Department of Chemical Engineering, IIT Kharagpur** conferred for her proposal on "Development of composite structures for the application in hydrogen storage and distribution integrated with sensor".

7. **Prof Jayant Kumar Singh, Poonam and Prabhu Goel Chair Professor (HAG), Department of Chemical Engineering, IIT Kanpur** conferred for his proposal on "To develop a high-throughput platform for accelerating the discovery for materials".

8. **Prof Sandeep Verma, Professor In-Charge, Gangwal School of Medical Sciences and Technology, IIT Kanpur** conferred for his proposal on "Chemically Engineered Thermostable Human Insulin for Diabetic Patients".

9. **Prof Mahesh S Tirumkudulu, Professor, Department of Chemical Engineering, IIT Bombay** conferred for his proposal on "Point-of-Care Blood Cell Counter".

10. **Prof Santosh Ansumali, Professor, Engineering Mechanics unit, JNCASR, Bangalore** conferred for his proposal on "In silico tools for modelling hemodynamics constituents and the responses of vascular walls".

Joint Initiatives with DST

I. India–Taiwan Programme of Cooperation in Science & Technology (DST–INAE)

The International Cooperation Division (ICD) of the Department of Science and Technology (DST) entrusted INAE with the implementation of the India–Taiwan Programme of Cooperation in Science & Technology from 2023 onwards. The programme is jointly coordinated with National Science and Technology Council (NSTC) and supports collaborative research through annual joint calls for proposals. Under the Call for Proposals (CFP) 2022, 11 projects were inherited from Global Innovation and Technology Alliance (GITA), which are currently under progress.

For the 2023 call, proposals were invited in five broad thematic areas:

(i) Artificial Intelligence, IoT (Internet of Things), Big Data, Cyber Security
(ii) Green Energy Technology/ Renewable Energy (solar energy and bioenergy)/ Clean Energy
(iii) Micro/Nano-electronics, Embedded Systems & Sensors
(iv) Biotechnology, Healthcare including Functional Genomics, Drug Development and Biomedical Devices, Agriculture and Food Sciences
(v) Aerospace Technology

Proposals were evaluated by a Project Evaluation Committee (PEC) constituted by DST, based on which 15 projects were approved and are currently being progressed. In the 2024 call, "Manufacturing Processes" was introduced as a new thematic area, while the earlier domain of Micro/Nano-electronics, Embedded Systems and Sensors was replaced with "Semiconductors and Communications." Following PEC evaluation, 15 projects were recommended and approved by DST.

The call for proposals for the year 2025 was open from 2 June to 31 July 2025 and covered five priority domains:

(i) Artificial Intelligence, Cyber Security, Quantum technology
(ii) Biotechnology, Healthcare including Functional Genomics, Drug Development and Biomedical Devices, Agriculture and Food Sciences
(iii) Green Energy Technology/ Renewable Energy (solar energy and bioenergy)/ Clean Energy
(iv) Semiconductor & Communication
(v) Green Manufacturing Technologies.

A total of 185 eligible proposals were received. The results will be jointly announced by INAE and NSTC post evaluation and approval by DST. The Joint Committee Meeting between DST and NSTC was held on 17 November 2025 in Taipei, during which both sides deliberated on the future activities of the programme.

II. Vaishvik Bharatiya Vaigyanik (VAIBHAV) Scheme – ICD, DST

The Vaishvik Bharatiya Vaigyanik (VAIBHAV) Fellowship Scheme, instituted by DST and implemented by INAE, aims to foster collaboration between Indian diaspora scientists and Indian higher education institutions, universities, and publicly funded research organizations. Under the call for proposal (CFP) 2023, 22 VAIBHAV Fellows and 2 Distinguished VAIBHAV Fellows were selected. The projects were sanctioned, funds were disbursed to eligible fellows, and visits to Indian host institutions were progressed. Post-visit reports from fellows who have completed their visits were obtained and submitted to DST. The processing of second-year funds for fellows selected under the 2023 call is in progress.

Under the CFP 2024, 17 VAIBHAV Fellows were selected by DST. First-year funding has been disbursed to 16 eligible fellows. The visits to Indian host institutions by the VAIBHAV Fellows are being progressed and their post-visit reports are being received and submitted to DST.

The list of VAIBHAV Fellows selected by DST and their affiliation can be viewed on INAE website at the link : https://www.inae.in/vaibhav-fellowship/

III. DST–Women International Grant Support (WINGS) Programme

The DST–Women International Grant Support (WINGS) Programme seeks to provide international research exposure to Indian women scientists, engineers, and technologists in order to enhance their scientific and research capabilities. The programme comprises three components: WINGS Internship of up to twelve months, WINGS Fellowship of up to twelve months, and WINGS Science Visit of up to one month. Administrative activities related to the implementation of the programme are currently in progress.

Events conducted by INAE from October to December 2025

Engineers Conclave 2025

This year twelfth edition of the Engineers Conclave was jointly organized by the Indian National Academy of Engineering (INAE) and the Indian Institute of Technology (IIT) Kanpur on October 28–29, 2025, at IIT Kanpur. The central theme of the Conclave was *"*Cyber Physical Systems*"*, With the two themes focusing on "Intelligent Systems" coordinated by Prof. Aditya K Jagannatham, Professor, Department of Electrical Engineering, IIT Kanpur and "Interdisciplinary Cyber Physical Systems" coordinated by Prof. Santanu Chaudhury, Vice-President, INAE, former Director IIT Jodhpur & Professor, Department of Electrical Engineering, IIT Delhi," which are critical for India's economic growth, social development, and national security, enabling the fusion of digital and physical infrastructure; the conclave addressed the challenges and opportunities for advancement in these niche

areas of engineering importance to the Nation. During the conclave, notable engineering luminaries deliberated on the state-of-the-art technologies and latest R&D developments in the overarching area of Cyber Physical Systems and delivered illuminating technical talks on the two critical themes of "Intelligent Systems" and "Interdisciplinary Cyber Physical Systems".

The Conclave was co-chaired by Mr. J.D. Patil, President, INAE & Member, Board of IN-SPACe; Chairman, Indian Space Association (ISpA); Trustee, L&T Employee Trust; Former Whole Time Director – Defence & Smart Technologies, Larsen & Toubro Limited; and Former Director, L&T Semiconductor Technologies Limited; and Prof. Manindra Agrawal, FNAE, Director, IIT Kanpur. The event brought together distinguished academicians, scientists, industry leaders, policymakers, and young researchers from across India to deliberate on the future of intelligent and cyber-physical technologies. The Conclave provided a vibrant platform for cross-sector collaboration, research exchange, and policy discussion in rapidly evolving technological domains.

The Conclave commenced with the traditional lighting of the lamp and invocation ceremony at the Outreach Auditorium, IIT Kanpur. Delivering the welcome address, Prof. Yogesh S. Chauhan, FNAE, Head of the Department of Electrical Engineering at IIT Kanpur, emphasized the significance of collaborative technological innovation, stating that "Platforms like the Engineers Conclave empower the nation's brightest minds to envision solutions for complex challenges across sectors collectively."

Prof. Yogesh S. Chauhan delivering Welcome Address during Engineers Conclave 2025

Prof. Manindra Agrawal, FNAE, Director, IIT Kanpur, in his address, highlighted the institute's growing contributions in intelligent systems and digital engineering. He mentioned that "*The future of Indian engineering lies in harnessing interdisciplinary synergies—especially in domains like intelligent systems and cyber-physical technologies—that can propel us toward a self-reliant and digitally empowered India".*

Prof. Manindra Agrawal, Director, IIT Kanpur and Co-Chair of Engineers Conclave 2025 delivering address during the Inaugural Session

Mr. JD Patil, President, INAE, in his Presidential Address**,** emphasized the pivotal role of engineers in enabling India's transition towards self-reliance in advanced technologies. He mentioned that "*The Conclave stands as a living example of how academia and industry can jointly shape policies, influence engineering education, and promote indigenous innovation for nation-building."*

Mr JD Patil, President, INAE and Co-Chair of Engineers Conclave 2025 delivering address during the Inaugural Session of Engineers Conclave-2025

The Chief Guest, Dr. S. Somanath, *FNAE*, Prof. Vikram Sarabhai Professor, ISRO; Chancellor, Chanakya University, Bengaluru; Former Secretary, Department of Space; and Former Chairman, ISRO delivered an inspiring address on India's technological progress and future in cyber-physical integration. *He emphasized that "Cyber-Physical Systems and Intelligent Engineering will form the backbone of India's next technological revolution-driving our space missions, smart infrastructure, and national security initiatives."*

The Chief Guest, Dr. S. Somanath delivering address during the Inaugural Session

The inaugural session concluded with a Vote of Thanks by Lt. Col. Shobhit Rai (Retd.), Deputy Executive Director, INAE.

The first plenary talk on *"Self-Reliant AI/ML in Engineering: Education, Research and Technology Development"* was delivered by Prof. P. P. Chakrabarti, FNAE, Department of Computer Science and Engineering & Former Director, IIT Kharagpur, and chaired by Dr. Sanak Mishra, Former President, INAE. The talk highlighted the transformative potential of AI and machine learning in education, research, and industrial innovation. He brought out that *"Artificial Intelligence, when coupled with indigenous research and ethical frameworks, can empower India to lead globally in digital innovation."*

Session Chair Dr Sanak Mishra, Former President, INAE felicitating Prof PP Chakrabarti, Plenary Speaker

The two-day event hosted plenary talks**,** parallel technical sessions**,** and networking interactions, providing a dynamic platform for eminent engineering experts, academicians, technology leaders and

administrators to conduct meaningful deliberations with fruitful outcome on the two themes. The event highlights included eight Parallel Technical Sessions on both themes which provided an opportunity for the delegates to gain knowledge of the latest technological developments, challenges and scope for future growth in allied areas. Eminent speakers from IITs, IISc, DRDO, ISRO, CSIR, and leading industries presented their work on next-generation communication networks, IoT and sensors, AI and data science, robotics, drone technologies, industrial automation, cybersecurity, and smart agriculture. The parallel technical sessions also encouraged interdisciplinary dialogue and showcased the convergence of AI, automation, and intelligent data systems as the backbone of future cyber-physical ecosystems.

The evening plenary talk titled *"Cyber Physical Systems in Defence Manufacturing – Industry 4.0 and Beyond"* was delivered by Mr. Jayant D. Patil, President, INAE, and chaired by Dr. P. S. Goel, Former President, INAE. Mr. Patil emphasized how Industry 4.0 principles and CPS frameworks are revolutionizing India's defence manufacturing by integrating AI-driven decision systems, autonomous production, and digital twins to ensure higher reliability, precision, and self-reliance. It was also brought out that "*Integrating cyber-physical systems into defence manufacturing will not only enhance precision and efficiency but also position India as a global leader in smart defence technologies".*

On Day 2, parallel panel discussions were held for both themes, moderated by Prof. Aditya K. Jagannatham Coordinator, Theme I and Prof. Santanu Chaudhury, *FNAE*, Coordinator, Theme II. Session Chairs being the panellist engaged in interactive discussions during this session, focusing on actionable strategies for fostering CPS-based innovation and policy frameworks to guide national development.

The Valedictory Session, chaired by Dr PS Goel, Former President, INAE, brought together the deliberations from all sessions. Mr. JD Patil, President, INAE presented the introductory remarks, while the theme coordinators summarized key takeaways and recommendations.

Valedictory Session Chair Dr PS Goel, Former President, INAE felicitating Prof. Nischal K Verma, Convener of EC-2025

In his concluding remarks, Dr Goel noted, "*Engineers Conclave 2025 has succeeded in identifying concrete technological pathways that can strengthen India's innovation ecosystem and bridge the gap between research and implementation*." The event concluded with a Vote of Thanks by Prof Nishchal Kumar Verma, Convener of EC-2025 followed by the felicitation of the Coordinators and the Organizing Team.

Valedictory Session Chair Dr PS Goel, Former President, INAE felicitating Prof. Aditya K Jagannatham, Coordinator, Theme I

Valedictory Session Chair Dr PS Goel, Former President, INAE felicitating Prof. Santanu Chaudhury, Vice-President, INAE and Coordinator, Theme II

Group Photograph during Engineers Conclave-2025 at IIT Kanpur

The *Engineers Conclave 2025* at IIT Kanpur was a resounding success, serving as a significant national platform for advancing dialogue on Cyber Physical Systems and their societal applications. The collaborative deliberations have laid the foundation for developing a strong ecosystem of innovation, education, and policy support for CPS in India. The actionable recommendations emerging from EC-2025 will be shared with relevant government departments, industries, and R&D agencies to further the growth of state-of-the-art indigenous technologies in the crucial areas of Intelligent Systems and Cyber Physical Systems-paving the way for a technologically empowered and self-reliant India. INAE and IIT Kanpur reaffirmed their joint commitment to nurturing technological excellence and contributing to India's vision of self-reliant, intelligent, and sustainable engineering systems.

The soft copy of the Souvenir of Engineers Conclave 2025 can be viewed by clicking here….

The Photographs of Engineers Conclave 2025 can be viewed by clicking on the link given below
https://www.dropbox.com/home/EC-2025/Photos%20EC-2025

The videos of Engineers Conclave 2025 can be viewed by clicking on the link given below
https://www.youtube.com/playlist?list=PLptXpBze00JWgIwGji5y8THp0F5GXxh3L

INAE Annual Convention 2025

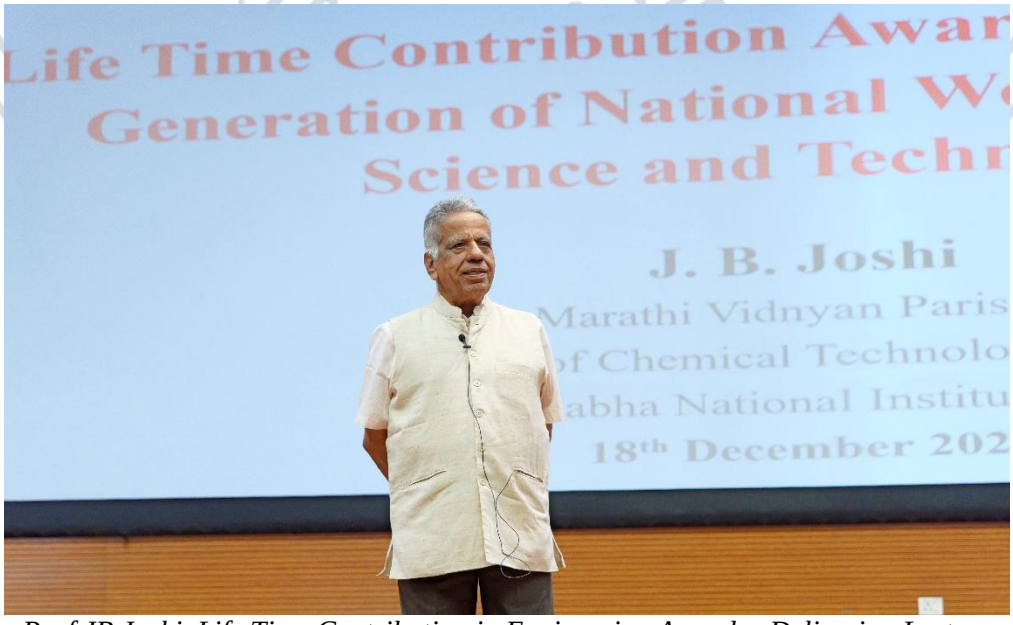
The INAE Annual Convention 2025 was organized on December 18-20, 2025 at HAL Management Academy (HMA), Bengaluru. INAE organizes its Annual Convention every year, during the month of December as one of its Flagship events. The Convention of the Academy is a mega event attended by Fellows, Foreign Fellows, Young Associates and Invitees. The Annual Conventions have been very successful with good attendance in the last several years.

The INAE Annual Convention 2025 commenced on Dec 18, 2025 with the Award Lectures by winners of INAE major Awards chaired by Dr PS Goel, Former President, INAE & Honorary Distinguished Professor at NIAS, Honorary Distinguished Professor ISRO; Formerly Secretary, Ministry of Earth Sciences. This session featured lectures by winners Life Time Contribution Award in Engineering; Prof. Jai Krishna & Prof. SN Mitra Memorial Awards; Outstanding Teacher Award and Woman Engineer of the Year Award instituted by the Academy to recognize engineering luminaries and stalwarts of engineering in different categories. The lectures presented a brief overview of the most distinguished

and noteworthy contributions of the awardees that have brought them honour and glory in the engineering realms. Recognizing talent in engineering is important at all stages for engineering professionals and one of the best ways is to confer awards that shall encourage and give a fillip to them.

INAE Life Time Contribution in Engineering Award is conferred to recognise life time contribution in engineering made by eminent persons to any branch of engineering within the purview of the Academy. This year's awardees are among the most eminent engineering personalities in present times. The two awardees for INAE Life Time Contribution in Engineering Award 2025 were Prof. J.B. Joshi, *FNA*E, Chancellor and Former Director, Institute of Chemical Technology, Mumbai, a renowned Chemical Engineer who has done truly outstanding work in developing design procedures for Multiphase Reactors which form heart of the chemical process and nuclear industry and Dr. Sanak Mishra, Former President, INAE and former President of the Indian Institute of Metals and formerly Managing Director, Rourkela Steel Plant and Director, Steel Authority of India Ltd.; Vice-President, ArcelorMittal and CEO India Projects and Secretary General, Indian Steel Association, both of whom have contributed immensely in their respective fields and walks of life and are highly acclaimed in the engineering community.

Dr Sanak Mishra, Former President, INAE & Life Time Contribution in Engineering Awardee delivering Lecture



Prof JB Joshi, Life Time Contribution in Engineering Awardee Delivering Lecture

Prof JB Joshi delivered an address on "Generation of National Wealth Through Science and Technology" and brought out some pertinent issues on this topic of vital interest to the Nation. Dr Sanak Mishra expounded some important issues of interest to industry and detailed his professional journey wherein he made contributions to the Steel Industry in various capacities that are being conferred the Life Time Contribution in Engineering Award which is the highest recognition given by the Academy.

INAE Prof Jai Krishna Memorial Award for the year 2025 was conferred on Prof. Anil Kumar Bhowmick, *FNAE*, former Professor of Eminence at the Indian Institute of Technology Kharagpur and Founder Director of IIT Patna and currently a faculty at the University of Houston, USA. INAE Prof SN Mitra Memorial Award for the year 2025 was conferred on Prof Bhim Singh**,** *FNAE***,** ANRF National Science Chair and Emeritus Professor, Department of Electrical Engineering, Indian Institute of Technology Delhi. The INAE Outstanding Teachers Award was instituted to honour engineering teachers who have excelled in the field of teaching in Indian Colleges, Universities, and Institutions, and have provided guidance towards technology development and inspired students to take up careers in Engineering and Technology and the two awardees were Prof. Sirshendu De, Professor, Department of Chemical Engineering, IIT Kharagpur and Prof. S.V. Kulkarni, Professor in the Department of Electrical Engineering at IIT Bombay The Academy instituted an award to honour woman engineers named as "INAE Woman Engineer of the Year Award" and this year the award is presented to Dr. Geetha Manjunath, Founder, CEO and CTO of NIRAMAI Health Analytix Private Ltd, Bengaluru who founded a startup that has pioneered a new non-invasive imaging test for detecting Early Breast Cancer. All these winners of major awards of INAE delivered inspiring and illuminating talks that indeed captured the attention of the august audience.

Prof Bhim Singh, INAE Prof SN Mitra Memorial Awardee Delivering Lecture

Prof Sirshendu De, INAE Outstanding Teacher Awardee Delivering Lecture

Prof SV Kulkarni, INAE Outstanding Teacher Awardee Delivering Lecture

INAE Woman Engineer of the Year Awardee Dr. Geetha Manjunath delivering Lecture

On Day 1 the INAE Governing Council Meeting was held and there was an illuminating session on "Introduction to INAE Membership" wherein briefing was done on the new streams of Membership of INAE introduced by the Academy to have a wider reach and participation of engineering community viz Corporate Membership; Institutional Membership and Individual Membership. While Fellowship being the Gold standards, all engineers may not rise to become a Fellow, there are many capable engineers in the country who would benefit being associated with INAE. The Membership portal was launched during this feature of the Convention which is an excellent way of bringing a larger section of engineering professionals under the umbrella of INAE.

The second day commenced with the Inaugural Session, after the traditional Invocation and lighting of the lamp illuminating addresses were delivered by the dignitaries on the dais. This year's Annual Convention was even more memorable as the Inaugural Session featured an enlightening address by Chief Guest - Prof. Ashutosh Sharma FNAE, President, INSA, Institute Chair Professor, Department of Chemical Engineering, IIT Kanpur and former Secretary to the Dept. of Science & Technology, Govt. of India. Prof Ashutosh Sharma delivered an enlightening address on "Making S&T Work/or Not" and his words of wisdom captivated the audience.

Prof Ashutosh Sharma, FNAE, Chief Guest Delivering Address during Inaugural Session

Mr JD Patil, President, INAE felicitating Prof Ashutosh Sharma, Chief Guest during INAE Annual Convention 2025

The Welcome Address by Mr. J.D. Patil, President, INAE and Address by Guest of Honour- Dr D.K. Sunil, *FNAE* Chairman & Managing Director, Hindustan Aeronautics Limited (HAL) also inspired the august audience. This year also as per tradition, there has been an overwhelming response for attending the subject event at Bengaluru at the scenic campus of HAL Management Academy (HMA), Bengaluru.

Mr JD Patil, President, INAE felicitating Dr DK Sunil, CMD, HAL- Guest of Honour during INAE Annual Convention 2025

Mr J.D. Patil, President, INAE in his welcome address gave an introduction of the Academy and shed light on the important issues of the Academy's journey towards financial and functional autonomy and the steps taken to generate Corpus Fund to meet the operational costs after disengagement from the Government as per directives w.e.f. April 1, 2025 onwards.

The highlights of the day were the Technical Presentations by newly elected Fellows & Young Engineer/ Innovator & Entrepreneur Awardees held in four parallel sessions. The audience was indeed delighted to listen to the highlights of the engineering accomplishments of the newly elected Fellows & Young Engineer/ Innovator & Entrepreneur Awardees and the interactive sessions were much appreciated by all. The most awaited feature of the Annual Convention was the Grand Awards Ceremony on Dec 19, 2025 wherein the family and friends of the awardees also joined the audience to laud and give rounds of applause to the awardees of the Young Engineer Award, Young Innovator & Entrepreneur Award, INAE Outstanding Teachers Award, Professor Jai Krishna Memorial Award and INAE Professor SN Mitra Memorial Awards, Women Engineer of the Year Award and Life Time Contribution Award in Engineering.

A few photographs of the Grands Awards Ceremony are given below. Balance photographs may be downloaded from INAE website at the link
https://www.dropbox.com/scl/fo/1rqfjgoz4a8w9q4yfsgie/AHdGBmaEbjNh4yf_VRV61X8/DAY%2002?dl=0&rlkey=z5ihq7ihkdy7gzrfzcswgl3gz&subfolder_nav_tracking=1

Presentation of INAE Young Innovator and Entrepreneur Award 2025

Presentation of INAE Woman Engineer of the Year Award 2025

Presentation of INAE Young Engineer Award 2025

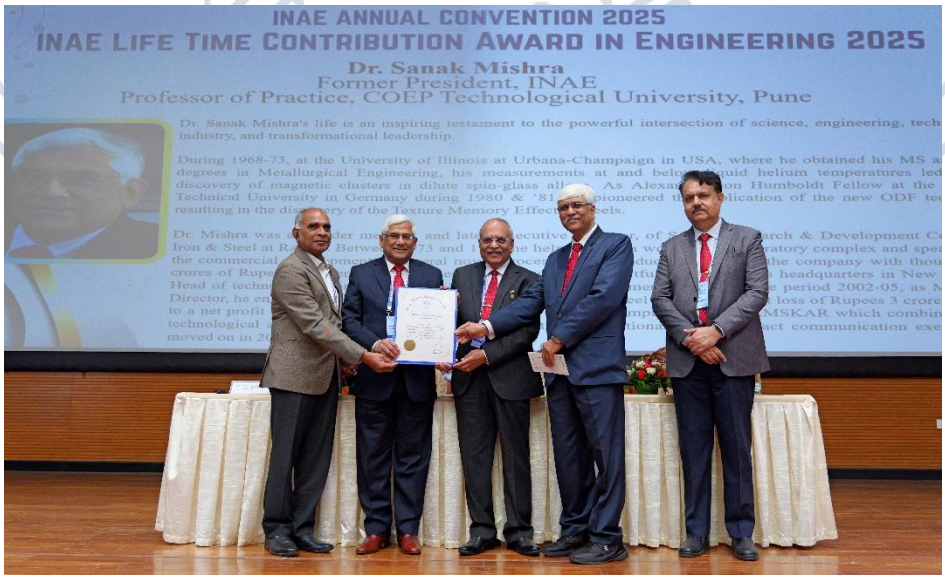
Prof AK Bhowmick being conferred INAE Prof Jai Krishna Memorial Award 2025 (online)

Prof Bhim Singh being conferred INAE Prof SN Mitra Memorial Award 2025

Prof Sirshendu De being conferred the INAE Outstanding Teachers Award 2025

Prof SV Kulkarni being conferred the INAE Outstanding Teachers Award 2025

Prof JB Joshi being conferred the INAE Life Time Contribution Award in Engineering 2025



Dr Sanak Mishra being conferred the INAE Life Time Contribution Award in Engineering 2025

It was a memorable evening that culminated in the Plenary Talk on "Commemorating 50 years of Solar in India: Achievements and Challenges" by Prof. Juzer M. Vasi, *FNAE*, Professor Emeritus, IIT Bombay who impressed the audience with his deep insights and depth of knowledge and experience. He brought out some of the most pertinent opportunities and challenges in India's foray in Solar energy and gave an overview of the history of Solar Photovoltaics in India; India's National Solar Mission and challenges and opportunities for the widespread adoption of Solar Energy in the country.

Prof Juzer Vasi Delivering Plenary Talk

Left to Right: Prof UB Desai, Vice-President, INAE; Prof Juzer Vasi and Mr JD Patil, President, INAE

At the end of the day the Gala Dinner was a networking opportunity and a pleasant way to close the day and was well attended by all Fellows, Young Associates, awardees, Dignitaries and Invitees and their families and a time for relaxation after the technical deliberations of the day.

One of the important features of the Convention is the Induction ceremony wherein newly elected Fellows and Young Associates are welcomed in the folds of the Academy. All INAE Young Engineer Awardees become Young Associates of the Academy until attaining the age of 45 years and the Induction Ceremony begun with welcoming them into the realms of INAE. This was followed by the Annual General Meeting (AGM) and Special General Meeting which was attended by only Fellows and Young Associates. During the AGM, besides the formal official proceedings, a Brainstorming Session was held wherein views were sought on important ongoing technical initiatives of the Academy as well as championing of new programs with support from the Fellowship and ways for furtherance of the

technical activities of INAE in line with its objective to advance the growth of engineering and technology and promote engineering education in the country and also increase its outreach in the National and International engineering domains.

An interesting feature of the day was the Fireside Chat with Mr. N.R. Narayana Murthy, FNAE, Founder Infosys on Dec 20, 2025 held on a topic covering future of engineering and technology in India and was a unique component of the program giving a flavour of the perspectives of a stalwart industry leader on issues of National engineering interest. The session was moderated by Prof. Indranil Manna, Immediate Former President, INAE who presented a plethora of mind searching questions which are extremely relevant in the present context for the technological advancement of the Nation. Mr Murthy had the audience spellbound with his deep insights and mentioned that engineers and INAE as a professional body of brightest engineering minds may consider addressing some national challenges like improvement of Air Quality Index; improvised methods of recycling of water and catalysing better agricultural practices. He expounded the way forward for propagation of Artificial Intelligence for a range of applications and novel ideas for technological advancement of the country through mentorship by eminent engineering experts from within and outside the country. He was happy to note that the Centre for Engineering Education Excellence (CEEE) program being implemented by INAE with CSR support from Infosys Foundation and partnership with AICTE and five of the oldest IITs at Kharagpur, Kanpur, Madras, Bombay and Delhi is progressing well and is playing a useful role in the growth of engineering education by facilitating mentoring of engineering teachers from lesser endowed engineering colleges and institutions by expert faculty members from the five IITs.

Prof Indranil Manna, Immediate Former President, INAE introducing Mr NR Narayana Murthy (right)

Left to Right: Prof Indranil Manna, Mr NR Narayana Murthy and Mr JD Patil, President, INAE

In the year 2025, INAE has 1033 Indian Fellows and 112 Foreign Fellows on its rolls identified in ten Engineering Sections who are elected in recognition of their personal achievements in engineering which are of exceptional merit and of distinctive eminence in new and developing fields of technology. The grand finale of the third day and the Annual Convention was the Induction Ceremony of newly elected Fellows and Foreign Fellows which is a unique recognition much sought after as it recognized engineering professionals who have reached a Gold Standard in their career paths.

A few photographs of the Induction Ceremony of Young Associates, Fellows and Foreign Fellows are given below. All balance photographs can be downloaded from INAE Website at the link

https://www.dropbox.com/scl/fo/1rqfjgoz4a8w9q4yfsgie/AJutkIGBLq2MpbKprMLvb2k/DAY%2003?dl=0&rlkey=z5ihq7ihkdy7gzrfzcswgl3gz&subfolder_nav_tracking=1

Induction Ceremony of Young Associates

Induction Ceremony of Fellows during AGM 2025

Induction Ceremony of Foreign Fellows During AGM 2025

(*To view the photographs of all 3 days of the INAE Annual Convention 2025 click on the link https://www.dropbox.com/scl/fo/1rqfjgoz4a8w9q4yfsgie/ADwaNgimj8hrt9IM7xSCUjU?rlkey=z5ihq7ihkdy7gzrfzcswgl3gz&e=1&st=mw6txmy9&dl=0)*

The enthralling three-day Annual Convention was enlightening and interesting for all participants and a much awaited event which is increasing in visibility and outreach with each passing year, in line with the noble objectives of the Academy and its contributions towards the growth of engineering and technology and engineering education, helping in paving the way for Nation Building and a *Viksit Bharat@2047*.

Sponsors: The INAE Annual Convention 2025 was partly supported by Hindustan Aeronautics Limited (HAL), Bengaluru and Bharat Electronics Limited (BEL), Bengaluru.

The Centre for Engineering Education Excellence (CEEE) Program

Summary: The Centre for Engineering Education Excellence (CEEE) Program, launched through CSR funding from the Infosys Foundation in partnership with the Indian National Academy of Engineering (INAE), is a transformative initiative aimed at elevating the quality of engineering education in India. Recognizing the pressing need to bridge the skills gap among engineering graduates, particularly from Tier 3 and 4 institutions, the ₹38.35 crore, four-year program (2024–2028) focuses on upskilling faculty members who teach core engineering subjects during formative undergraduate semesters. By leveraging the mentorship of INAE Fellows, domain experts, and senior faculty from premier institutions, the program delivers a blended model of physical and virtual training across five key engineering domains. With a goal to mentor nearly 3,750 faculty members through 125 mentors by its conclusion, CEEE seeks to indirectly impact thousands of engineering students, enhancing their employability and innovation capacity. A robust governance structure ensures accountability and quality, while competitive financial support enables widespread participation. This initiative exemplifies a powerful collaboration between industry and academia, advancing national goals such as Skill India and contributing meaningfully to the vision of a Viksit Bharat by 2047.

The formal press release was released on 19th December 2024 and link for the same is:

https://www.infosys.com/newsroom/press-releases/2024/collaborate-transform-engineering-education-india.html

The MoU has been signed with Infosys Foundation, AICTE and IITs Kharagpur, Madras, Bombay, Kanpur and Delhi.

The program focuses on faculty engaged in teaching core, fundamental courses during the second, third, and fourth semesters - a critical stage where students acquire essential engineering concepts. The five domains covered under the initiative include:

- Computer Science and Information Technology (including Data Science and AI/ML)
- Electrical, Electronics, and Instrumentation Engineering
- Mechanical, Aerospace, and Energy Engineering
- Materials, Chemical, and Biomedical Engineering
- Civil and Environmental Engineering

For each domain, five strategically selected core subjects have been identified. The faculty selected for this program (mentees) would undergo a combination of intensive physical mentorship and virtual training annually. The physical mentorship for two-week program was conducted during the summer months (from 26th May-18th July 2025) wherein a total of 871 Mentees had undergone the physical mentoring by the renowned IIT faculty. This was followed by a two to three-week virtual mentorship program till 31st December 2025.

Building on the experience of the 2025 cycle, the CEEE Programme will transition to a fully automated implementation model from 2026 onwards. This transition is expected to improve efficiency, scalability, and participant outreach, enabling the programme to achieve its annual target of 1,250 mentees. Overall, the CEEE Programme aims to mentor approximately 3,750 faculty members through 125 mentors by 2028, contributing meaningfully to national initiatives such as Skill India and the vision of Viksit Bharat @2047.

Local Chapter Activities and Webinar Series held during October to December 2025

The following Webinars/activities/meetings/Technical Lectures were conducted during October 2025 to December 2025 by INAE Local Chapters.

INAE Bhubaneswar Chapter

(i) The 66th lecture of the INAE Distinguished Lecture Series was organized by INAE Bhubaneswar Chapter, jointly with SOA University, CSIR-IMMT Bhubaneswar, IIT Bhubaneswar, NISER Bhubaneswar and IEEE Bhubaneswar Sub-section and delivered by Prof. Rahul Mitra**,** Department of Metallurgical and Materials Engineering, Indian Institute of Technology Kharagpur on 25th October, 2025 on "Design and Development of Materials for Ultra-High Temperature Aerospace Applications"

Key Points: The rapid technological growth of the aerospace sector in recent years has driven the development of materials for use under extreme environments at temperatures beyond the limit of the Nickel based superalloys. In this context, molybdenum (Mo) and niobium (Nb) silicide based refractory intermetallic alloys as well as the carbon fibre reinforced silicon carbide (Cf-SiC) composites are considered candidate materials to increase the operating temperatures of aero-engines, whereas the ZrB2-SiC based ceramic composites are attractive for potential applications in nose-cones and leading edges of hypersonic vehicles. These materials are designed to retain strength and resist environmental degradation at high temperature, as well as exhibit adequate fracture toughness at room temperature. Ductile phase toughened Mo-Si-B alloys containing Moss (ss for solid solution), Mo3Si and Mo5SiB2 as well as Nb-Si alloys with Nbss and Nb5Si3 phases are found to exhibit impressive strength retention along with oxidation resistance till 1200 oC, with significant improvement caused by Zr addition to Mo-Si-B alloys, and Mo+Ti+Zr additions to Nb-Si based alloys. The oxidation resistance of Mo-Si-B alloys is contributed by the formation

of a self-healing top layer of borosilicate glass. However, this is preceded by mass loss due to vaporization of MoO3, which can be minimized by forming ternary non-volatile oxidation products.

The Cf-SiC composites designed with Si-B-C modified matrix and weak interphase of multi-layered (PyC-SiC)n exhibits increase in strength with temperature along with a typical damage tolerant behaviour caused by crack bridging by the partially debonded fibres. In the ZrB2-based ultra-high temperature ceramic composites, addition of 20 vol% SiC not only aides in densification through pressureless sintering, but also leads to an optimum combination of thermal shock and ablation resistance. Processing of green products by gel-casting followed by pressureless sintering provides a promising route to fabricate near-net shaped large products for high performance applications. Both densification and oxidation resistance of the spark plasma sintered ZrB2-SiC composites is improved on LaB6 addition, which contributes to the formation of a stable and protective outer layer of borosilicate glass. Additional benefits including superior toughness along with oxidation and ablation resistance are obtained in the hybrid Cf-ZrB2-SiC, processed by infiltrating ZrB2-SiC slurry into C-fibre preforms. Selected experimental results along with the involved mechanisms were discussed.

Bio Data: Prof. Rahul Mitra received B.Tech (Hons.) in Metallurgical Engineering from IIT Kharagpur in 1988 and Ph.D. in Materials Science and Engineering from Northwestern University, Evanston, Illinois, USA in 1992. Thereafter, he joined the DMRL, Hyderabad as scientist, and in 2002 he moved to IIT Kharagpur, where he is a Professor of Metallurgical and Materials Engineering, and served as Head during April 2017-December 2020. He also served as the Head, School of Nano Science and Technology during October 2016 - December 2020, and Chairman, Central Research Facility during December 2009 - November 2017. He was on sabbatical at Northwestern University, Evanston, Illinois and University of Southern California. His research is focused on silicide based intermetallic alloys, ultra-high temperature ceramic matrix composites as well as Carbon-fibre reinforced composites with emphasis on microstructure, deformation and oxidation behavior for nearly three decades. He has also worked on processing and mechanical behavior of lightweight metal-matrix composites as well as nanocrystalline thin films.

He has worked as Principal Investigator on several sponsored projects with the total value exceeding INR 16 Crores. He has authored/co-authored 219 publications in peer reviewed journals, 11 book chapters, and two patents (h-index: 45 and i10 index = 157 by Google Scholar), as well as guided 30 PhD students to completion. Furthermore, he has authored a book, “Structural Intermetallics and Intermetallic Matrix Composites” published in 2015 by CRC Press, Taylor and Francis Group, and has also edited a book with the title, “Intermetallic Matrix Composites: Properties and Applications”. He is recipient of the MRSI Medal in 2003, the Metallurgist of the Year award in 2014, and the G.D. Birla Gold Medal in 2021. He has been elected fellow of the Indian National Academy of Engineering (INAE) in 2016, the Electron Microscopy Society of India (EMSI) in 2017, the Indian Institute of Metals (IIM) in 2022, the National Academy of Sciences, India (NASI) in 2023, and the Indian National Science Academy (INSA) in 2025. He is a member of the Editorial board of Sadhana, published jointly by Springer and Indian Academy of Sciences, as well as Editorial Advisory Board of the Transactions of the Indian Ceramic Society published by Taylor and Francis.

He has served as Expert Member (or presently a member) in several National Committees under DST (FIST and WoS schemes), SERB (NPDF, SRG, CRG, SUPRA, POWER), and DRDO (NRB and ARDB-GTMAP). Presently, he is a subject expert member of the Engineering Sciences Research Committee for CSIR's Extramural Research (EMR) Schemes in the area of Engineering Sciences, Technical Programme Committee (TPC) for the Materials, Mining and Minerals Engineering of Advanced Research Grant (ARG) under Anusandhan National Research

Foundation (ANRF), New Delhi, as well as DRDO-Industry-Academia Centres of Excellence at IISc Bengaluru, IIT Kanpur and IIT-BHU, Varanasi.

You Tube Video Recording Link : https://youtu.be/r9vjF7hGxT4
People Participated: 43

(ii) The 67th lecture of the INAE Distinguished Lecture Series was organized by INAE Bhubaneswar Chapter, jointly with SOA University, CSIR-IMMT Bhubaneswar, IIT Bhubaneswar, NISER Bhubaneswar and IEEE Bhubaneswar Sub-section and delivered by Prof. Suddhasatwa Basu, FIPI Chair Professor, Indian Institute of Technology Delhi, on 1st November, 2025 on "Hybrid Metal Phosphonates and Perovskite-Cobaltite Materials as Electrode Materials for Energy Conversion Devices"

Key Points: Developing a low-cost effective, readily available, highly efficient electrocatalyst is essential to produce clean and sustainable energy. To convert or generate electrical energy through fuel cell technology and create an environmentally benign atmosphere, the conversion of water to hydrogen and oxygen via electrochemical hydrogen evolution reaction (HER) and oxygen evolution reaction (OER) effectively using renewable energy sources is key to the success and have gained huge interest over the years. One of the ways net zero goal can be achieved is to use and store intermittent renewable energy sources in rechargeable ion-batteries and in the form of hydrogen by splitting water and use fuel cell technologies in future. However, researchers are struggling last two decades to make these technologies economically viable and competitive to today's fossil fuel-based energy sources keeping the cost band US$ 100-150 per kWh. Thus, the design and synthesis of the highly efficient and affordable electrocatalysts are crucial to address this matter by replacing the state-of-the-art PGM (Pt group of metals) catalyst for water electrolyser / fuel cell or Li and Co free solid state battery technologies.

The research team has worked towards investigating the structure-property-performance relationship employing NASICON cathode and hard carbon anode for the sodium-ion battery implementation. Polyanionic compounds, e.g, Na3V2(PO4)2F3 (NVPF), suffer from the intrinsic drawbacks of poor electronic conductivity, limited reversible capacity, and severe volume alterations during intercalation-deintercalation cycling. To address these issues, we have explored the synergistic contribution of morphology control and surface modulation via non-metallic element doped carbon coating on the electrochemical activity of Na3V2(PO4)2F3 material in half-full coin cell orientation. Zn ion battery suffers from short circuiting due to dendrite formation by the physical, electrical, or chemical factors, resulting sudden exothermic reactions, can lead to a fire. The application of a protective layer ZIF 8 based MOF on the zinc anode has proven to be an effective approach for aqueous zinc-ion batteries (ZIBs). By employing this approach, the battery life in a symmetric cell configuration was extended to 1000 hours at 0.5 mA/cm² for the anode with the protective layer, while minimizing zinc dendrite growth. Additionally, the development of a zeolitic imidazolate framework-67-derived Co_3O_4/α-MnO_2 cathode host for aqueous ZIBs has been conducted. Long-term GCD tests in a half-cell CR-2032 coin cell configuration demonstrated a high discharge capacity retention of over 90% after 2000 GCD cycles, with nearly 100% coulombic efficiency. We have worked on development of all solid-state cobalt free Li-ion battery (ASSLB) in collaboration with Bar-Ilan University, which is based on LiNiO2 (LNO) cathode coated with LiAlZnO2 (LAZO) protective layer of 4 nm thickness along with argyrodite solid electrolyte which is safe and durable. LAZO@LNO-based ASSLB deliverred a high specific capacity of 4.65 mAh•cm–2 (184.48 mAh•g–1) and 4.14 mAh•cm–2 (159.5 mAh•g–1) with a good capacity retention of 81.46% after 60 cycles and 70.31% after 200 cycles at a current density of 0.454 mA•cm–2 (0.1C, 35 ºC, 150 MPa) and 0.934 mA•cm–2 (0.2C, 35 ºC, 150 MPa), respectively.

Decreasing the operating temperature can widen the material selection range but limits the commercialization of IT-SOFC (intermediate temperature solid oxide fuel cell) due to the sluggish oxygen reduction reaction (ORR) kinetics at the cathode side operating at lower temperature. In this regard, mixed ionic and electronic conductors (MIEC's) such as lanthanum strontium iron cobaltite (LSCF) enhances ORR kinetics, by providing extended triple phase boundary (TPB) but face thermal expansion coefficient (TEC) mismatch and chemical incompatibility challenges. Substitution of Co with Fe addresses the issue of thermal expansion mismatch and the replacement of La with smaller lanthanides are also found to reduce TEC as Ln-O bond ionicity decreases for smaller lanthanides. Nd-based perovskites ($Nd_{1-x}Sr_xCo_{1-y}Fe_yO_{3-\delta}$) balances both thermal expansion and electronic conductivity due to the intermediate ionic size of Nd^{3+} and intermediate ionicity of Nd-O bond. We designed and developed a potentially efficient IT-SOFC cathode material, $Nd_{0.67}Sr_{0.33}Co_{0.8}Fe_{0.2}O_{3-\delta}$ (NSCF), by auto-combustion synthesis. Anode-supported SOFC, employing NSCF as cathode exhibits outstanding power densities of 2.27, 1.52 and 0.86 W/cm² respectively at 800, 750 and 700°C. In solid oxide electrolysis cell (SOEC) mode, with NSCF as anode/cathode catalyst i.e., in symmetrical SOEC configuration and with a NSCF-GDC buffer layer exhibits good CO_2 reduction current density (-1.100 A/cm²) and endurance to 55 h of testing.

Bio-data: Prof. Suddhasatwa Basu completed Ph.D./MS in Chemical Engineering from Indian Institute of Science, Bangalore. He holds Federation of Indian Petroleum Industry (FIPI) Chair Professor on Clean Energy at IIT Delhi. Earlier, He was the Director of CSIR-Institute of Minerals & Materials Technology, Bhubaneswar and the Director of Central Institute Mining & Fuel Research, Dhanbad. He has vast work experience on development of materials for energy conversion and storage devices – Green H2 & Fuel Cells technology and rechargeable battery materials, electro-synthesis, wastes to wealth technologies for circular economy. He has published more than 290 articles in high impact journals with H-index 56, 16 patents (10 granted) and 2 technologies transferred. He is a Fellow of National Academy of Science of India, Indian National Academy of Engineering, Royal Society of Chemistry UK and received Fullbright fellowship, Herdillia Award, Dr A. V. Rama Rao Foundation's Research Award, SMC Gold Medal, MRSI Medal. He is Editor/Assoc Editor/Ed Board member of several international journals published by Willey, Springer, Oxford University Press and Am Chemical Soc.

People Participated: 53

(iii) The 68th lecture of the INAE Distinguished Lecture Series was organized by INAE Bhubaneswar Chapter, jointly with SOA University, CSIR-IMMT Bhubaneswar, IIT Bhubaneswar, NISER Bhubaneswar and IEEE Bhubaneswar Sub-section and delivered by Prof. Sirshendu De, Professor, Department of Chemical Engineering, Indian Institute of Technology Kharagpur on 8th November, 2025 on "In-house Scalable Low Cost Technologies for Water Treatment".

Key Points: With the ever dissipation of natural sources, the technologies with zero discharge are in high demand. However, if such technologies are imported they are expensive. On the other hand, the efforts of the researchers should be directed to develop indigenous technologies that has advantages, like, scalability, economic and technical viability, easy operation and maintenance. In this talk, some of these technologies were presented in detail including the treatment of groundwater and industrial wastewater. The groundwater treatment includes the removal of arsenic and fluoride. The wastewater treatment involves the treatment of the effluent generated from the rice mill effluent, cyanide removal from the steel industry effluent, organic removal from the refinery effluent, etc. A detailed description of these technologies, lab development, scaling up, deployment in the field, etc. were discussed.

Bio-data: Prof. Sirshendu De did his B. Tech (1990), M. Tech (1993) and PhD (1997) from Department of Chemical Engineering, IIT Kanpur. His main research interest includes membrane separation, membrane casting and applications, water treatment, modeling and design, transport in microchannel. He has authored 8 books, 21 patents, 383 publications in journals of repute with H index 71 and handled more than 50 research projects and transferred 6 technologies for commercialization to 11 companies. He has guided 32 PhD and 60+ M. Tech students. Prof. De has been awarded several awards, including Institute Chair Professorship, 2020, Abdul Kalam Fellowship for Innovative Research 2017, INAE Chair Professorship 2015, Shanti Swarup Bhatnagar Prize in "Engineering Science" by CSIR, Govt of India (2011). He is a Fellow of Indian National Academy of Engineers, New Delhi, The National Academy of Sciences, India, Allahabad, Indian Academy of Sciences, Bangalore and Indian National Science Academy, New Delhi. He is the founder of the spin-off company M/s, Technoquips Separation Pvt. Ltd.

You Tube Video Recording Link : https://youtu.be/gII209nxgOY
People Participated : 32

(iv) The 69th lecture of the INAE Distinguished Lecture Series was organized by INAE Bhubaneswar Chapter, jointly with SOA University, CSIR-IMMT Bhubaneswar, IIT Bhubaneswar, NISER Bhubaneswar and IEEE Bhubaneswar Sub-section and delivered by Prof. Samit K. Ray, Department of Physics, IIT Kharagpur on 12th November, 2025 on "Emerging Semiconductor Technologies: Trends and Perspectives".

Key Points: India has recently launched Indian Semiconductor Mission (ISM) and National Quantum Mission (NQM) to boost the economy and make the country self-reliant in all aspects. On the other hand, the progress in renewable energy sector has become significant in the last few decades. The potential of some emerging semiconductor based materials and devices for photonic, quantum and energy harvesting devices were discussed. The progress of emerging two-dimensional (2D) transition metal dichalcogenides, inorganic perovskites and their heterostructures for photonic and energy harvesting devices were presented. Hybrid heterostructures comprising of zero-dimensional materials on 2D semiconductors having excellent photosensitive characteristics offer the possibility to achieve next generation optoelectronic devices with superior functionalities. This has been demonstrated through giant photo-amplification in highly stable α-$CsPbI_3$ NCs on layered WS_2 mixed-dimensional heterostructures photo-FET with asymmetric contacts. On the other hand, utilizing the superior luminescence properties and high colour purity of inorganic perovskite nanocrystals, we reported the fabrication of colour-saturated $CsPbBr_{3-x}I_x$ (x=0-3)/ZnO heterojunctions based white light emitting diodes on a flexible platform. Finally, recent trends in piezotronics and tribotronics for self-powered, flexible electronic devices were discussed.

Bio-data: Prof. Samit K. Ray is a Chair Professor in the Department of Physics, IIT Kharagpur. He has previously served as the Director S. N. Bose National Centre for Basic Sciences, Kolkata, Dean (Post-graduate & Research Studies), Head, Department of Physics and Chairman, School of Nanoscience and Technology, IIT Kharagpur. His research interests are in the area of semiconductor materials & devices, quantum technology, low dimensional materials, photovoltaics and nanophotonic devices. He has served as a visiting faculty/scientist at the Tokyo Institute of Technology, Japan, University of Delaware, USA, University of Texas at Austin, USA, Queens University of Belfast, UK and Chang Gung University, Taiwan. Prof. Ray is an elected fellow of the Indian National Science Academy (w.e.f. 01.01.2026), Indian Academy of Sciences, National Academy of Sciences India, Indian National Academy of Engineering and West Bengal Academy of Science & Technology. He is also the recipient of INSA Young Scientist Award, UGC Homi Bhabha Award, INAE Chair Professor fellowship, MRSI Superconductivity & Materials Science Senior Award etc. He has published more than 430

research papers in peer reviewed journals and several book chapters. He is serving as an editorial board member of the journal Nanotechnology (IOP, UK), Nano Future, Scientific Reports and Frontiers in Materials: Optics and Photonics.

You Tube Video Recording Link : https://youtu.be/1qLkQuIEKp8
People Participated: 42

(v) The 70th lecture of the INAE Distinguished Lecture Series was organized by INAE Bhubaneswar Chapter, jointly with SOA University, CSIR-IMMT Bhubaneswar, IIT Bhubaneswar, NISER Bhubaneswar and IEEE Bhubaneswar Sub-section and delivered by Prof. Sudip Misra, INAE Chair Professor, Department of Computer Science & Engineering, Indian Institute of Technology, Kharagpur on 22nd November, 2025 on "All Things Connected: The Age of Intelligent Networks*"*.

Key Points: Today we live in a smart and intelligent world, in which everything is connected. This transformation from traditional networks to ubiquitous connectivity has been enabled through the use of Internet of Things (IoT) coupled with AI. Everyday objects equipped with sensors, actuators and embedded processors can seamlessly communicate with each other through a layered architecture consisting of perception, edge and cloud components. This enables the realization of a wide array of applications from smart agriculture, healthcare, education, campus management to defence and warfare. These applications have enormous economic and societal benefits with the potential to transform lives across spectrums. The talk emphasized on the widespread use of IoT and its amalgamation with ML/AI for developing impactful real-world solutions for persistent issues that exist such as crop health monitoring through UAVs, predictive industrial monitoring and physiological monitoring through body wearables. It discussed several products and solutions that have been designed at SWAN Laboratory, IIT Kharagpur as well as it discusses emerging business opportunities driven by the convergence of AI and IoT. Towards future intelligent networks characterized by autonomous self-learning nodes and network components, this talk laid the foundational technologies and concepts required for achieving hyper-intelligence and connectedness including the ethics and morals of using widespread AI.

Bio Data: Prof. Sudip Misra is the INAE Chair Professor in the Department of Computer Science and Engineering at the Indian Institute of Technology Kharagpur. He received his Ph.D. degree in Computer Science from Carleton University, Ottawa, Canada. His current research interests include Wireless Sensor Networks and the Internet of Things. Over his illustrious career, Prof. Misra has published over 550 scholarly research papers and 12 books. He has won over a dozen research paper awards in different conferences and IEEE journals. Formerly, he was the INAE Abdul Kalam Technology Innovation National Fellow. He was awarded the IEEE ComSoc Asia Pacific Outstanding Young Researcher Award at IEEE GLOBECOM 2012, California, USA. He was also the recipient of several academic awards and fellowships such as the Faculty Excellence Award (IIT Kharagpur), Young Scientist Award (National Academy of Sciences, India), Young Systems Scientist Award (Systems Society of India), Young Engineers Award (Institution of Engineers, India), (Canadian) Governor General's Academic Gold Medal at Carleton University, the University Outstanding Graduate Student Award at the Doctoral level at Carleton University, the National Academy of Sciences, India among many others. Prof. Misra has served in the Editorial Board of high impactful journals and transactions of IEEE and ACM. He is a Fellow of the ACM, IEEE, National Academy of Sciences India (NASI), Indian National Academy of Engineering (INAE), the Institution of Engineering and Technology (IET), UK, British Computer Society (BCS), UK, Royal Society of Public Health (RSPH), UK, and the Institution of Electronics and Telecommunications Engineering (IETE), India. Professor Misra was the Distinguished Lecturer of the IEEE Communications Society. He has been serving on the Executive Committee of IEEE Kharagpur Section since 2008 in different capacities and was the

Chair of the IEEE Kharagpur Section. He is also the Director and Co-Founder of the IoT startup, SensorDrops Networks Private Limited (http://www.sensordropsnetworks.com).

You Tube Video Recording Link : https://youtu.be/_r82HY4Ei70
People Participated: 38

(vi) The 71st lecture of the INAE Distinguished Lecture Series was organized by INAE Bhubaneswar Chapter, jointly with SOA University, CSIR-IMMT Bhubaneswar, IIT Bhubaneswar, NISER Bhubaneswar and IEEE Bhubaneswar Sub-section and delivered by Prof. P J Narayanan, IIIT Hyderabad on 11th December 2025 on "Interpretability in Computer Vision".

Key Points: Modern Computer Vision is based on Neural Networks that are often black-boxes that give little justifications on how they make their decisions. This is unsatisfactory for several critical applications. Interpreting or explaining how a network arrives at it decision has been an active area of research in Machine Learning in recent years. In this talk, he outlined the key concepts in interpretability and their usage with respect to Computer Vision research.

Bio Data: Dr P J Narayanan is a Professor at IIIT, Hyderabad and a researcher in the areas of 3D vision, computational cameras, and parallel computing. He joined IIIT-H in 2000, was its Dean of Research from 2006, and was its Director from 2013 till 2025. He got his bachelors from IIT, Kharagpur and his PhD from the University of Maryland, all in Computer Science. He was a research faculty member at the Robotics Institute of Carnegie Mellon University from 1992 to 1996 and a scientist at the Centre for Artificial Intelligence and Robotics, Bangalore. He was the President of ACM India from 2009 to 2014 and a member of ACM's Technology Policy Council. P J Narayanan is a Fellow of the Indian National Academy of Engineering and an Nvidia CUDA Fellow.

You Tube Video Recording Link : https://youtu.be/eLNw2L1jZZw
People Participated: 40

(vii) The 72nd lecture of the INAE Distinguished Lecture Series was organized by INAE Bhubaneswar Chapter, jointly with SOA University, CSIR-IMMT Bhubaneswar, IIT Bhubaneswar, NISER Bhubaneswar and IEEE Bhubaneswar Sub-section and delivered by Prof Subhasis Chaudhuri, IIT Bombay on 12th December 2025 on "Continual Learning (… and forgetting too)".

Key Points: We spend a lot of time in training a network to recognize different but a fixed number of types of objects in a scene. If we are to induct new object classes subsequently in the recognition engine, should we be retraining the network from scratch again? Can we tweak the network so that it can incrementally learn new classes of object? Unfortunately, any attempt to incrementally learn new concepts may also lead to forgetting, often catastrophic, of previously learnt concepts. Similarly, can we also selectively forget a few concepts that may be required for socio-technical reasons? In this talk, discussions were held on how some of this objectives can be achieved.

Bio Data: Prof. Subhasis Chaudhuri is currently the K.N. Bajaj Chair Professor at Indian Institute of Technology Bombay. He did his B.Tech. from IIT Kharagpur and Ph.D. from University of California, San Diego (UCSD). He has held a number of important positions at IIT Bombay, such as, Head, Dept. of Electrical Engineering; Dean (International Relations); and Deputy Director (Academic & Infrastructure Affairs). During the period April 2019 to May 2024, he served as the Director of IIT Bombay and stewarded it to reach an all-time high QS world ranking of 118. He has received several major national awards recognizing his research excellence,

which include the Shanti Swarup Bhatnagar Prize, Swarnajayanti Fellowship, J.C. Bose National Fellowship, G.D. Birla Award among several others. He is a Fellow of all science and engineering academies in India as well as that of IEEE and TWAS. He has been recognized as a Distinguished Alumnus of IIT Kharagpur and UCSD. He was conferred D.Sc. (honoris causa) by Burdwan University. Prof. Chaudhuri is an Independent Director and the Chairperson of the Board of Bombay Stock Exchange (BSE).

You Tube Video Recording Link : https://youtu.be/Q1_81vIvH48
People Participated: 35

(viii) A Special talk was organized in hybrid mode by C.V. Raman Global University, Bhubaneswar, INAE Bhubaneswar Chapter, SOA University and IEEE Bhubaneswar Section by Prof. Radhakant Padhi, HAL Chair Professor, Dept. of Aerospace Engineering, Indian Institute of Science, Bangalore on 8th December 2025 on "Role of Optimal Guidance in Soft-Landing of Chandrayaan-3".

Key Points: High-precision autonomous soft-landing is increasingly becoming an essential requirement for various inter-planetary missions and also missions of unmanned aerial vehicles. A good soft-landing algorithm must fulfill various conditions, such as high terminal position, velocity and acceleration accuracy, continuity between phases, recovery from path perturbations, and prevention of altitude excursion. Moreover, autonomous soft-landing in space missions needs to be carried out with the limited capability of on-board processors, thereby necessitating a closed-form expression of the guidance law. Essentials of a Jerk-minimizing optimal guidance having all these features were presented in this talk, including its relevance for the Vikram lander in connection with the Chandrayaan-3 mission. This talk will also include some of the lessons learnt from the unsuccessful attempt of Chandrayaan-2 and the improvements carried out subsequently that led to the success of the Chandrayaan-3 mission. Experiments carried out in the outdoor environment using drones as a confidence building measure prior to the mission were included in the talk as well.

Bio Data: Prof. Radhakant Padhi, a Ph.D. from the Missouri University of Science and Technology, Rolla, USA, is currently the HAL Chair Professor at the Department of Aerospace engineering in the Indian Institute of Science, Bangalore; and also an Associate Faculty at its Centre for Cyber-Physical Systems. He is a Fellow of Indian National Academy of Engineering, Aeronautical Society of India, Astronautical Society of India, IETE, and Institute of Engineers India. He is an Associate Fellow of AIAA and a Senior Member of Institute of IEEE. He is the Director of Operations of the Automatic Control and Dynamic Optimization Society of India. He is an Associate Editor of Unmanned Systems journal, and has been an associated editor of two more journals in the past in the control and automation field.

Prof. Padhi's research interest is on optimal and nonlinear control synthesis algorithms and their applications to challenging practical problems in aerospace, biomedical and mechanical engineering as well as other application areas such as process control and laser beam pointing control. He has co-authored nearly 300 peer-reviewed publications; and a book on Satellite Formation Flying. Two more books on "Intelligent Adaptive Control" and "Optimal Control and State Estimation" are being finalized, and will be published soon.

Prof. Padhi is a member of technical review committees for several missions of ISRO and DRDO, including the performance analysis committee which analyzed the reasons for partial failure of Chandrayaan-2 mission and suggested the necessary improvements for the Chandrayaan 3 mission. His recent passion is his two deep-tech startups incubated in IISc, namely VAPL.tech and VTPL.tech, one focusing on Advanced Guidance and Control of aerospace vehicles for challenging missions and the other focusing on on diabetes care. Through

these, he intends to focus on utilizing his knowledge and experience for the real benefit of the country and, by extension, the mankind.

People Participated: 250

INAE Mumbai Chapter

INAE Mumbai Chapter organized a Webinar on "A new Era of Process Management and Sustainability", by Professor (Dr.) Aniruddha B. Pandit**,** Vice Chancellor, Institute of Chemical Technology, Matunga, Mumbai at Veermata Jijabai Technological Institute (VJTI) Mumbai on 14th November 2025 from 1600-17:30 hours in hybrid mode.

The programme started with welcoming the speakers and distinguished participants by Prof. Sujata Parameswaran, HOD, Chemistry Department, VJTI. Dr. Gopika Vinod, Secretary, INAE Mumbai Chapter gave a brief presentation on INAE Local chapter activities. She also brought out the importance of the topic of the webinar. Prof. K.K. Sangle, Professor & Dean Academic Programmes, VJTI gave glimpses about activities at VJTI.

The Talk by Prof. Pandit emphasized on sustainability issues, such as earth overshoot day, ecological foot print with role of trade, how many earths needed by various countries depending on current consumption patterns based on national footprint and biocapacity, eco efficiency in the domain of process system engineering and need for life cycle assessment. He also introduced concepts such as Exergy evaluations (energy available for doing useful work), renewability vs thermodynamic ROI. These concepts were explained in relation to the laws of thermodynamics. The talk was attended by students and faculty members of VJTI. Dr. R. B. Grover and Prof. P. Gogate attended in person and various INAE fellowships joined online. The talk was followed by interactive session with fellowships and students.

Photographs from the event are given below

Shri. A. K. Balasubrahmanian -INAE Mumbai Chapter Chair, Shri. A. K. Balasubrahmanian has been appointed as Chairman of Atomic Energy Regulatory Board (AERB) with effect from January 01, 2026. Prior to this, he was serving as Chairman of Project Design Safety Committee for Pressurized Heavy Water Reactor (PHWR) based NPPs, Member Safety Review Committee for Operating Plants, AERB, Mumbai and former Director (Technical) and Distinguished Scientist at NPCIL. He has nearly 40 years of experience in design, development, safety assessment, construction and commissioning of Nuclear Power Plants. He has extensive experience in the development of ageing management strategies related to PHWRs. With his contributions in the design and development of a number of first-of-a-kind (FOAK) systems with innovative design and safety features and indigenization efforts for PHWR technology, he is considered an all-round expert in reactor technology. Apart from PHWRs, he is also well-versed in different reactor technologies.

INAE Mumbai Chapter wishes him success in the new role as nation moves through an interesting phase of nuclear governance.

INAE Hyderabad Chapter

INAE Hyderabad chapter conducted a technical meet on the topic “Compact laser plasma source for high energy electrons, x-rays and protons” on 28 November 2025 at CHESS, DRDO, Hyderabad. The meeting was chaired by Dr. Madhusudan Reddy, FNAE, President - INAE, Hyderabad Chapter. Dr Jaiteerth R. Joshi, FNAE, CEO & MD (BrahMos) also joined the meeting in-person. Several INAE Fellows attended the talk through internet VC and in-person. Prof. M. Krishnamurthy, Centre Director, from Tata Institute of Fundamental Research, Hyderabad delivered the talk. He discussed in detail about theory and experimental results of generation of “intense ultrashort pulse lasers that generate relativistic electrons”.

Memento presented by Dr. Madhusudan Reddy, President- INAE, Hyderabad Chapter to Prof. M. Krishnamurthy Centre Director, TIFR.

Lecture session attended by INAE Fellows online and in-person.

INAE Chennai Chapter

A Webinar on "Materials informatics for heat transfer and beyond" was co-hosted by ISHMT and INAE Chennai Chapter on October 8, 2025 as the 19th talk in the ISHMT Golden Jubilee Webinar series in partnership with INAE Chennai Chapter on the topic, wherein a lecture was delivered by Prof. Junichiro Shiomi, Department of Mechanical Engineering, University of Tokyo.

INAE Forums

One of the important objectives of the Academy is to assist the Government from time to time in formulating policies on critical technical issues. These forums enable giving inputs to policy makers, institutes of higher learning & research, industries, etc. The following are the updates on activities carried out by INAE Forums during the period October to December 2025.

INAE Forum on Civil Infrastructure

The INAE Forum on Civil Infrastructure has undertaken comprehensive study of the problem involving not only the engineering issues, but also other related ones such as, policy interventions needed, societal involvement, and, regulatory mechanisms. The Forum held a series of meetings on November 4, December 6 and December 31, 2025 to review the progress of its ongoing study on issues related to civil infrastructure in India and to deliberate on the preparation of a comprehensive report. The meetings were attended by members of the Forum along with invited experts, and detailed discussions were held on the structure and content of the proposed report. Emphasis was placed on integrating technical aspects with broader considerations relating to policy, regulatory frameworks, and societal engagement in infrastructure development.

In order to enrich the report with relevant and updated information, members were requested to interact with institutions and experts working in related fields. Inputs were sought from organizations dealing with buildings, transportation, sustainability, and construction technologies. Discussions were also held on establishing relationships between projected material requirements, costs, and the associated carbon footprint of infrastructure development, particularly in cement, steel, and other construction materials, as well as the need to consider emerging sustainability concerns such as embodied carbon and environmental impact. The Forum emphasized that the scale and unique context of the Indian infrastructure scenario must be carefully taken into account. The recommendations emerging from the study are expected to be prioritized, with those considered most critical for implementation in the next five to ten years receiving the highest priority. The Forum considered the possibility of preparing case studies related to infrastructure projects, such as buildings and bridges, which could illustrate practical approaches to reducing carbon footprints and improving sustainability in the built environment. The report is under preparation and shall be finalized shortly.

INAE Research Schemes

I. INAE Chair Professorship and INAE Distinguished Professors/Technologists

The Governing Council, at its 157th meeting held on December 18, 2025, approved the following recommended nominations for the INAE Chair Professorship 2025 for the tenure from 1 January 2026 to 31 December 2028.

1) Prof Bidyadhar Subudhi, Director and Professor, Electrical Engineering, NIT Warangal.
2) Dr Archana Sharma, Distinguished Professor, Dr. SPM IIIT Raipur, Chhattisgarh.
3) Prof CSP Ojha, Professor, HAG, Department of Civil Engineering, IIT Roorkee.
4) Prof Debatosh Guha, Professor, Institute of Radio Physics and Electronics, University of Calcutta.

In view of eligibility criteria not being met in respect of the nominee for INAE Distinguished Professor/Technologists, no nominee was recommended.

II. Mentoring of Engineering Students by INAE Fellows/ INAE Young Associates

Applications for the year 2026–27 under the scheme "Mentoring of Engineering Students by INAE Fellows/Young Associates" were invited during the first week of February 2026. The last date for receipt of nominations is 10 April 2026.

International Affairs

CAETS Energy Community

As the only engineering Academy of the country, INAE represents India at the International Council of Academies of Engineering and Technological Sciences (CAETS) and participates in its programmes of global concern for benefits at national/international levels. CAETS is committed to enhancing the contribution of science, technology and engineering in the world and its mission is to foster effective engineering and technological progress for the benefits of the societies of all countries. Nominees from INAE represents on various CAETS Working Groups and Committees.

Mr Pradeep Chaturvedi, Vice-President, INAE had been a member of the CAETS Energy Committee since past few years, contributing significantly to the preparation of two Reports on Energy during his period. Since the term of Prof. Axel (Canada), immediate former Chairman was nearing its completion, the Committee members discussed the nomination for the next Chairman. CAETS Energy Committee members with the guidance of and Dr. Yves Bamberger (France), former Chairman of the Committee communicated that in recognition of Mr. Pradeep Chaturvedi's effective contributions, they proposed his name as the next Chairman at the Brisbane CAETS 2025 Annual Meeting during the first week of September 2025, which was an honour for the Academy. Dr Ajay Mathur, has been co-opted as the Co-Chair of the CAETS Energy Community. An internal meeting has since taken place during October 2025 to plan the way forward for the CAETS Energy Community. The plan was also shared with the immediate Former Chairman and Former Chairman also during December 2025. A concept note has since been developed and circulated to all member academies along with the plan of action to bring a out a report on Sequel Project' on "Towards Reliable Low-Carbon Energy for All: Assessment of Risks and Opportunities."

Election of Fellows and Foreign Fellows 2026

Nominations for Fellowship and Foreign Fellowship have been invited in January 2026 with last date of March 31, 2026 which has been extended to April 15, 2026 after due approval and notification posted on INAE website accordingly. Details on the nomination process are posted on INAE website at the link https://www.inae.in/forms/

INAE Young Engineer Award 2026

Nominations have been invited for INAE Young Engineer Award 2026 with last date of March 31, 2026 which has been extended to April 15, 2026 after due approval and notification posted on INAE website accordingly. Details on the application process are posted on INAE website at the link https://www.inae.in/inae-young-engineer-award/

INAE Publications

Transactions of Indian National Academy of Engineering – An International Journal of Engineering and Technology"

INAE is currently publishing a Journal named "Transactions of Indian National Academy of Engineering – International Journal of Engineering and Technology" published by M/s Springer which was earlier named INAE Letters. Transactions of INAE - Volume 10, Issue 4, December 2025 was published through Springer Publishers during the period October 2025 to December 2025.

INAE *TechFrontier*

INAE has launched a quarterly e-Magazine, *INAE TechFrontier*, aimed at showcasing emerging trends, impactful research, and technological innovations in engineering and technology, with a strong focus on issues of national and global relevance. The magazine was formally launched during the INAE Foundation Day celebrations on 20 April 2025 and has received an encouraging response from the engineering and technology community.

The initial issues of *INAE TechFrontier* include:

- **Issue I, Volume I:** *Quantum Technology: India-centric Policy Perspectives* - Focus on India-centric policy frameworks guiding the growth of quantum technologies.
  Click to view: INAE-TechFrontier - Volume I, Issue I,April 2025
- **Issue II, Volume I:** *Manufacturing* - highlighting India's drive towards technological self-reliance and global competitiveness
  Click to view: INAE TechFrontier Volume I, Issue II (August 2025)
- **Issue III, Volume I:** *Cyber-Physical Systems* - exploring the integration of computation, communication, and control across key sectors
  Click to view: INAE TechFrontier Volume I, Issue III (December 2025)

The forthcoming issue, **Volume I, Issue IV** of *INAE TechFrontier*, will be devoted to the theme **"Sustainability of Civil Infrastructure"** for release shortly. This issue aims to present practical insights, technological innovations, and forward-looking perspectives that promote sustainability in the planning, design, construction, operation, and maintenance of civil infrastructure.

INAE's Progress on Donations & Membership Schemes

In accordance with the directive from the Department of Science and Technology (DST) dated 6th May 2022, the Indian National Academy of Engineering (INAE) has moved towards full financial and functional autonomy, with government Grant-in-Aid concluding on 1st April 2025. To ensure long-term sustainability, INAE has implemented a strategic plan—endorsed by its Fellowship and approved by DST- centred around the creation of a dedicated Corpus Fund, supported by six key revenue streams:

- Corporate and institutional memberships,
- Individual donations/membership,
- CSR contributions,
- Government/project support, and
- Publication

INAE gratefully acknowledges generous contributions and commitments from leading corporates and institutions, including HAL, Google, Infosys Foundation, Microsoft, and others, as well as memberships from premier academic and research organizations. These contributions affirm strong confidence in INAE's mission and significantly support its journey toward financial self-reliance. INAE has 31 Institutional Members (25 Diamond, 1 Ruby, 5 Coral), and 207 Individual Members (145 Senior and 62 Associate). HAL has become Patron Corporate Member.

Donations to INAE Corpus Fund

INAE had faced an unexpected development because of the decision of the Government conveyed through the Department of Science and Technology that the funding of INAE would cease from April 1, 2025 onwards. Therefore, a lot of measures had to be taken to counter the situation and the Governing Council took the decision that INAE should raise its own corpus so as to become not only functionally but financially autonomous. A target to achieve about Rs 100 Crores was set so that the annual interest of Rs 5-6 Crores could meet the operational cost of the Academy. Since then, good progress has been made and substantial commitment and contributions have been received, which shall ensure the continuance of the Academy and that INAE would not only survive but thrive.

INAE leadership had appealed to the Fellowship for contributions to the INAE Corpus Fund, emphasizing the importance of collective support during the transition to financial autonomy. Contributions are seen as a shared responsibility of the entire Fellowship.

In recognition of donors, INAE has a **Wall of Donors** on its website at the link https://www.inae.in/wall-of-donors/

Account Details and QR code:
Account Name: INAE Corpus Fund
Account No.: 41790835603
Bank: Branch – NIHFW, Munirka (earlier old JNU), New Delhi
IFSC: SBIN0001624
Account Type: Savings

Tax Benefits:
Donations qualify for 50% tax deduction under Section 80G (for those under the old tax regime), with receipts and certificates issued within a quarter.

INAE expresses deep gratitude to all supporters and continues to welcome contributions from Fellows, Young Associates, Awardees, and Corporate partners, which are essential to ensuring INAE's long-term self-reliance and mission continuity.

Important Meetings held during October to December, 2025

Oct 15, 2025	Meeting of INAE Forum on Civil Infrastructure held at New Delhi in hybrid mode
Oct 24, 2025	Meeting of the Annual Convention Organizing Committee (ACOC) for INAE Annual Convention 2025 held over WebEx
Oct 31, 2025	Meeting of Committee on INAE Awards 2025 held over WebEx
Nov 4, 2025	Meeting on CEEE Program: Way Forward held over WebEx
Nov 4, 2025	Meeting of INAE Forum on Civil Infrastructure held at New Delhi in hybrid mode
Nov 5, 2025	Meeting of National Advisory Committee (NAC) for INAE Annual Convention 2025 held over WebEx
Nov 6, 2025	Selection Committee meeting for INAE Young Innovator & Entrepreneur Award 2025 held over WebEx

Nov 18, 2025	PMAC Review Meeting (Online & Digital Gaming Research Initiative) held at New Delhi in hybrid mode
Nov 21, 2025	Second Meeting of the Annual Convention Organizing Committee (ACOC) for INAE Annual Convention 2025 held over WebEx
Nov 25, 2025	Royal Academy of Engineering, UK (RAEng) and INAE meeting to discuss proposed joint initiative
Nov 28, 2025	45th Finance Committee Meeting held at New Delhi in hybrid mode
Nov 28, 2025	55th Apex Committee meeting held at New Delhi in hybrid mode
Nov 28, 2025	Selection Committee meeting for INAE Awards 2025 held over WebEx
Dec 1, 2025	Meeting with Conveners regarding Publication of Technology Roadmap Articles held over WebEx
Dec 6, 2025	Meeting on INAE Forum on Civil Infrastructure held at New Delhi in hybrid mode
Dec 11, 2025	Meeting to discuss regarding INAE-RAEng collaborative activity on Critical Minerals held over WebEx
Dec 17, 2025	Meeting with Springer Representative on INAE Journal: MoU with Springer held over WebEx
Dec 18, 2025	157th Governing Council Meeting of INAE held at HAL, Bengaluru in hybrid mode
Dec 19, 2025	Meeting with Conveners Reg. Publication of Technology Roadmap Articles held at HAL, Bengaluru in hybrid mode
Dec 19, 2025	INAE-HAL Joint Advisory Committee Meeting held at HAL, Bengaluru in hybrid mode
Dec 20, 2025	37th Annual General Meeting (AGM) of Fellows (Part-B) held at HAL, Bengaluru in hybrid mode
Dec 24, 2025	Meeting of Board of Management CEEE Program held over WebEx
Dec 31, 2025	Meeting on INAE Forum on Civil Infrastructure held at New Delhi in hybrid mode

Back to Main Page

INTERNATIONAL/NATIONAL CONFERENCES/SEMINARS BEING ORGANIZED BY IITS/OTHER INSTITUTIONS

International Conference on Recent Advances in Multidisciplinary Engineering (ICRAME 2026) being held online and in-person on 1st to 2nd April 2026 at Lucknow, Uttar Pradesh
https://blaxez.github.io/ICRAME2026/

International conference On Ground Engineering & Sustainable Infrastructure (ICGESI-2026) being held in-person on 3rd to 4th April 2026 at Hamirpur, Himachal Pradesh
https://nith.ac.in/icgesi2026/index.html

International Conference on Innovations in Engineering for Sustainable Transformations (InnovEST 2026) being held online and in person on 3rd to 4th April 2026 at Jamshedpur, Jharkhand
https://www.innovest2026.in/

6TH International Conference on recent Trends in Engineering Technology and Management 2026 being held online and in-person on 10th to 11th April 2026 at Coimbatore, Tamil NADU.
https://icretm.in/

International Conference on Advances in Communication, Medical Electronics and Smart Grid Automation (ACMESGA 2k26) being held online and in-person on 22nd to 23rd April 2026 at Kalyani, West Bengal,
https://www.jiscollege.ac.in/ACMESGA/index.html

IEEE International Conference on Sustainable and Futuristic Technologies 2026 (ICSFT-2026) being held online and in-person on 24th to 25th April 2026 at Pune, Maharashtra
https://mmcoe.edu.in/international-conference-2026/

2nd International Conference on Sustainable Industry 4.0: Innovations for a Greener Future (ICSI 2026) being held in-person on 24th to 25th April 2026 at Pune, Maharashtra,
https://engg.dypvp.edu.in/icsi-2026/default.aspx

6th International Conference on Recent Advances in Mechanical Engineering and Nanomaterials (SCOPUS) being held online and in-person on 30th April to 2nd May 2026 at Palghar, Maharashtra,
https://icramen.rame.org.in/sjcem2026/

International Conference on Innovations in Engineering for Sustainable Transformations (InnovEST 2026) Conference being held online and in-person on 3rd to 4th April 2026 at Jamshedpur, Jharkhand.
https://www.innovest2026.in/

3rd International Conference on Advancing Knowledge from Multidisciplinary Research in Engineering, Technology and Science Conference being held in-person on 6th to 7th April 2026 at Chennai,
https://jsarap.org/icakmrets.php

6th International Conference on recent Trends in Engineering Technology and Management 2026 Conference being held online and in-person on 10th to 11th April 2026 at Coimbatore, Tamil Nadu.
https://icretm.in

ICBBES 2026 2nd International Conference on Biomanufacturing, Bio-Innovation, and Environment Sustainability being held online and in-person on 10th to 11th April 2026 at Mohali, Punjab.
https://www.cuchd.in/conference/icbbes-26/#about

IEEE International Conference on Sustainable and Futuristic Technologies 2026 (ICSFT-2026) Conference being held online and in-person on 24th to 25th April 2026 at Pune, Maharashtra. https://mmcoe.edu.in/international-conference-2026

17th International Conference on Recent Engineering and Technology 2026 Conference being held online and in-person on 8th to 9th May 2026 at Bangalore, Karnataka.
https://www.icret.in/

3rd International Conference on Biotechnology and Bioinformatics Conference being held in-person on 27th to 30th May 2026 at Solan, Himachal Pradesh.
https://www.juit.ac.in/icbab-2026/

2nd International Conference on Emerging Trends in Microelectronics, Communication and Intelligent Systems Conference being held online and in-person on 29th to 30th May 2026 at Pune, Maharashtra.
https://mitaoe.ac.in/ETMCIS/

International Conference on Structural Engineering and Construction Management (SECON'26) Conference being held online and in-person on 3rd to 5th June 2026 at Ernakulam, Kerala.
https://sites.google.com/fisat.ac.in/10dot00amsecon26

IEEE 6th International Conference on Emerging VLSI & Semiconductor Technology (EVST 2026) Conference being held in-person on 26th to 27th June 2026 at Ghaziabad, Uttar Pradesh. Website: https://www.kiet.edu/evst2026/

8th International Conference on Engineering and Advancement in Technology 2026 Conference being held online and in-person on 26th to 27th June 2026 at Hyderabad, Telangana. https://www.iceat.in/

Back to Main Page

Honours and Awards

(covering the period October to December 2025)

1	Mr JD Patil, FNAE, President, INAE, Former Whole Time Director (Defence & Smart Technologies) and Member of Executive Committee of Management, Larsen & Toubro Limited; Former Director L&T Semiconductor Technologies Limited; Former Chairman L&T MBDA Missile Systems Limited, Member of the Board of IN-SPACe; Chairman Indian Space Association (ISpA); Trustee L&T Employee Trust; Past President and Founder Vice President Society of Indian Defence Manufacturers was conferred with the Life Time Achievement Award of All India Manufacturing Technology Design and Research Conference at IIT-Indore on December 11, 2025.
2	Prof. (Dr.) Ganapati D. Yadav, *FNAE,* Former Vice-Chancellor of the Institute of Chemical Technology (ICT), Mumbai; Bhatnagar Fellow; National Science Chair; Padma Shri awardee, and Chairman of BOG, LITU, Nagpur has been appointed as the Chairman of the Scientific Advisory Committee on Hydrocarbons by the Ministry of Petroleum and Natural Gas, Government of India. In addition, the Government of Gujarat has nominated Prof GD Yadav as member of the Governing Board of Gujarat Technological University. The Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru has conferred Prof Yadav with Honorary Professorship.
3	Prof. Amit Agrawal, *FNAE,* Professor, Department of Mechanical Engineering, Indian Institute of Technology Bombay, Mumbai was conferred the "Distinguished Alumni Award 2025" by Indian Institute Technology Kanpur during the 66th Foundation Day celebrations of IIT Kanpur on November 2, 2025, in recognition of his ground-breaking research in fluid mechanics, heat transfer, and the development of novel bio-microdevices and in advancing the fundamental understanding and its applications in microscale flow systems.
4	Dr. Baba N. Kalyani, *FNAE,* Chairman & Managing Director, Bharat Forge Ltd., Pune was honoured with the prestigious CNN-News18 Indian of the Year Award 2025 in the Business category, which was presented in the presence of Mr. Amitabh Kant, Former CEO of NITI Aayog, and Justice Indu Malhotra (Retd.) at an awards ceremony at New Delhi on 28th November 2025. The celebrates his unmatched legacy in engineering, manufacturing, and defence innovation, and key role in transforming Bharat Forge from a domestic forging company into one of the world's most respected and advanced manufacturing and defence technology enterprises.
5	Prof. Sankar K. Pal, FNAE, Distinguished Scientist & Former Director, Indian Statistical Institute (ISI), Kolkata and former SERB National Science Chair, and President and Emeritus Professor, Indian Statistical Institute (ISI), Kokata was conferred Doctor of Science (D.Sc.), *honoris causa* from Sai University, Chennai on 24th October 2025. Prof. Sankar K. Pal has also been selected as an ANRF Prime Minister Professor, Government of India, designated to be hosted at the IIIT Bhubaneswar, Odisha, for improvement of the research ecosystem by mentoring of young scientists, researchers and students. The selection of this prestigious award was announced by the Anusandhan National Research Foundation (ANRF), Department of Science and Technology (DST), Govt. of India in December 2025 and he assumed this new position on February 2, 2026.
6	Prof. A.B. Pandit, *FNAE,* Vice Chancellor, Institute of Chemical Technology, Mumbai and former Vice-President, INAE has been conferred the "Rashtriya Vigyan Puraskar 2025-Vigyan Shri Award" in the field of Engineering Sciences by the Government of India in recognition of his exceptional contributions in pioneering research in chemical engineering, process intensification, and translational research has shaped generations of scientists, innovators, and entrepreneurs.

7	Prof. T Pradeep, *FNAE,* Institute Professor, Department of Chemistry, Indian Institute of Technology Madras, Chennai has been conferred the "Rashtriya Vigyan Puraskar 2025-Vigyan Shri Award" in the field of Chemistry by the Government of India in recognition of his exceptional contributions in path-breaking research in clean water technologies and molecular materials.
8	Prof. Mohanasankar Sivaprakasam, *FNAE,* Professor, Department of Electrical Engineering, Indian Institute of Technology Madras, Chennai has been conferred the "Rashtriya Vigyan Puraskar 2025-Vigyan Yuva Award" in the field of Technology and Innovation by the Government of India in recognition of his exceptional contributions in pioneering research pioneering contributions in biomedical engineering and healthcare innovation focused on creating accessible, technology-driven healthcare solutions, directly impacting both patient care and the national innovation landscape.
9	Dr. S. Venkata Mohan, *FNAE,* Director and INAE-SERB Abdul Kalam Technology Innovation National Fellow, CSIR-National Environmental Engineering Research Institute (NEERI), Nagpur has been conferred the "Rashtriya Vigyan Puraskar 2025-Vigyan Shri Award in the field of Environmental Science by the Government of India in recognition of his exceptional contributions in pioneering research in environmental biotechnology, focusing on metabolic modulation of microorganisms for applications in energy generation, waste valorization and environmental restoration.
10	Dr. Sharmila S Mande, *FNAE,* Ayush Distinguished Scientist Chair, Ministry of Ayush; Guest Professor, IIT-Gandhinagar and Visiting Professor of Practice, IIT-Kanpur was conferred the "Distinguished Alumna Award 2025" by Indian Institute of Science, Bangalore in recognition of her exceptional contributions in building one of India's first large-scale computational biology research programmes and her pioneering work on the human microbiome for translation into diagnostics and healthcare solutions.
11	Prof. S.M. Yusuf, *FNAE,* Director, UM-DAE Centre for Excellence in Basic Sciences and Former Director, Physics Group of Bhabha Atomic Research Centre (BARC), Mumbai has been conferred the "Rashtriya Vigyan Puraskar 2025-Vigyan Shri Award" in the field of Atomic Energy by the Government of India in recognition of his exceptional contributions to Atomic Energy, specifically in the area of safe nuclear power and in inspiring future scientists.
12	Prof. Prem Krishna, *FNAE,* Formerly Professor & Head of Civil Engineering Department, IIT Roorkee was conferred the "Lifetime Achievement Award" from the IIT Roorkee Alumni Association, during their Global meet held in Delhi on 03 January, 2026. Prof Prem Krishna was also elected unanimously as an 'Honorary Fellow' of the Indian Association of Structural Engineering by its Governing Council. The Indian Concrete Institute honoured Prof Prem Krishna with their "Lifetime Achievement Award 2025" in a ceremony held on December 9, 2025 at Hyderabad.
13	Prof. M.R. Madhav, *FNAE,* Professor Emeritus, JNT University; Visiting Professor, IIT, Hyderabad was conferred the Outstanding Contributions Medal for the year 2025 by International Association for Computer Methods and Advances in Geomechanics (IACMAG) during the 17th IACMAG Conference held at Hong Kong on 18-21 December, 2025.
14	Dr Purnendu Ghosh, former Vice-President, INAE and Executive Director, Birla Institute of Scientific Research, Jaipur was presented with *Hindi Seva Puraskar 2025* on September 14, 2025 given by the Language and Library Department for the promotion and upliftment of Hindi and has been awarded this year in the genre Scinec, technology and engineering for his book titled "*Vaigyanik Vichar Dwipon ke Beech Samajik Kavya Pulon ka Nirman*".

Back to Main Page

NEWS OF FELLOWS

(covering the period October to December 2025)

1	Mr. AK Balasubrahmanian, *FNAE*, Former Distinguished Scientist & Director (Technical), Nuclear Power Corporation of India Ltd, Mumbai has been appointed as Chairman, Atomic Energy Regulatory Board (AERB) w.e.f. January 1, 2026.
2	Professor UB Desai, *FNAE*, Former Director, Indian Institute of Technology Hyderabad and Former Professor, Department of Electrical Engineering, Indian Institute of Technology Bombay has assumed the position of Vice-President (Fellowship Affairs), INSA w.e.f January 1, 2026.
3	Prof. Sankar K. Pal, FNAE, Distinguished Scientist & Former Director, Indian Statistical Institute (ISI), Kolkata and former SERB National Science Chair, and President and Emeritus Professor, Indian Statistical Institute (ISI), Kokata has been appointed as a Visiting Distinguished Professor at IIT Indore for the period 2025-2027.
4	Prof. GD Yadav, *FNAE*, Emeritus Professor of Eminence, Institute of Chemical Technology, Mumbai has assumed the position of Vice-President Vice-President (Resource Generation and Management), Indian National Science Academy (INSA) w.e.f January 1, 2026.
5	Dr. Debabrata Das, *FNAE*, Former Professor, Head and Renewable Energy Chair Professor Department of Biotechnology Former Professor-in-Charge P K Sinha Center for Bioenergy Indian Institute of Technology, Kharagpur; Former INAE-AICTE Distinguished Visiting Professor SRM Institute of Science and Technology, Chennai Heritage Institute of Technology, Kolkata Scientific Advisor Dhampur Sugar Mills Ltd., New Delhi co- authored a book titled "Environmental Biotechnology: Advanced Technology for combating pollution" published by M/s. Springer, Switzerland.
6	Prof Sudip Misra, *FNAE*, INAE Chair Professor, Department of Computer Science & Engineering Indian Institute of Technology Kharagpur has been honoured by IIT Kharagpur with Institute Chair Professor award w.e.f. from January 1, 2026.

Back to Main Page

OBITUARIES

Prof. Vaidyeswaran Rajaraman

(September 08, 1933- November 8, 2025)

Prof. Vaidyeswaran Rajaraman, FNAE born on September 8, 1933 passed away on November 8, 2025. He was elected to INAE Fellowship in the year 1987 and affiliated to Engineering Section II (Computer Engineering and Information Technology).

Prof. Vaidyeswaran Rajaraman, FNAE, Emeritus Professor and former Former TataChem Professor & Chairman, Supercomputer Education and Research Centre (SERC), Indian Institute of Science, Bangalore was a pioneering computer scientist, visionary educator, and one of the chief architects of Computer Science education in India. He joined IIT Kanpur in 1963 as a faculty member wherein he played a pivotal role in shaping the early computing curriculum. In 1982, he joined the Indian Institute of Science where he guided research in high-performance computing and contributed significantly to India's indigenous supercomputing initiatives. From the analog computing laboratories of the 1950s to the supercomputing centres of the 21st century, his work helped lay the intellectual and institutional foundations of India's digital era. Prof Rajaraman was a recipient of several prestigious awards and honours including the Shanti Swarup Bhatnagar Prize, Om Prakash Bhasin Award, Homi Bhabha Prize, Distinguished Alumnus Award of the Indian Institute of Science, INAE Lifetime Contribution Award in Engineering and the Padma Bhushan. He was a Fellow of the Indian Academy of Sciences, Indian National Science Academy and INAE, among others. Prof Rajaraman nurtured several generations of students who went on to define the country's scientific and digital future, and set the stage for India's emergence as a major software power.

May God bless his soul to rest in peace

Prof. Pasala Dayaratnam

(November 23, 1932- November 11, 2025)

Prof. Pasala Dayaratnam, FNAE born on November 23, 1932 passed away on November 11, 2025. He was elected to INAE Fellowship in the year 1994 and affiliated to Engineering Section I (Civil Engineering).

Prof. Pasala Dayaratnam, Former Vice-Chancellor, Jawahar Lal Nehru Technological University, Hyderabad and Professor and former Head, Civil Engineering Department, IIT Kanpur had made significant research contributions in the areas of Structural Engineering and Prestressed Concrete Structures. His work on the theory and application of engineering principles for the design and maintenance of civil engineering structures is well recognized. Prof Dayaratnam was a dedicated academician and institution builder and was widely respected as an outstanding teacher and mentor of students. He was a prolific writer and had authored several influential books used in engineering education providing a strong foundation in the fundamentals of Structural Engineering. A few notable titles of books authored by him include Prestressed Concrete Structures; Brick and Reinforced Concrete Structures; Design of Steel Structures; Structural Engineering and Cable Stayed, Supported and Suspension Bridges. He was a Fellow of the Institution of Engineers India and the Indian National Academy of Engineering. He received a lifetime achievement award from the Indian Concrete Institute in recognition of his outstanding contributions to the growth of concrete technology and construction.

May God bless his soul to Rest in Peace

Prof. Pradipta Kishore Dash

(January 29, 1941- November 19, 2025)

Prof. Pradipta Kishore Dash, *FNAE* born on January 29, 1941 passed away on November 19, 2025. He was elected to INAE Fellowship in the year 1998 and affiliated to Engineering Section V (Electrical Engineering).

Prof. Pradipta Kishore Dash, Formerly Professor and Chairman, Centre for Intelligent Systems, Department of Electrical Engineering, REC, Rourkela; Formerly Director, Sillicon Institute of Technology, Bhubaneswar; Formerly Director, College of Engineering, Bhubaneswar; Formerly Vice-Chancellor, Siksha 'O' Anusandhan University and Dean (PG & Research), Institute of Technical Education & Research, Bhubaneswar had made significant research contributions in the areas of Energy Management and Artificial Intelligence. His pioneering contributions in the area of Power System Protection, Monitoring and Control included introducing the Computational Intelligence and Advanced Signal Processing techniques to build Digital Relaying schemes for the protection of generators, transformers, and transmission lines. In monitoring and instrumentation, he had postulated new techniques in building Fourier analyzer and Kalman filters for measuring voltage, current, power and frequency, and harmonics in Power systems facilitating the building of newer and faster protective devices. He published/ presented 520 research papers in International Journals or in conferences and guided more than 75 PhD scholars. He was awarded the Samanta Chandrasekhar Award in Engineering by the Government of Odisha and Odisha Bigyan Academy in 1990 and the Biju Patnaik Award for excellence in scientific research in 2010 by Odisha Bigyan Academy.

May God bless his soul to rest in peace

Back to Main Page

ENGINEERING AND TECHNOLOGY UPDATES

Civil Engineering

1. This new Building Material pulls Carbon out of the air

Researchers at Worcester Polytechnic Institute (WPI) have developed a new building material that removes more carbon from the atmosphere than it produces. The advance pertains a material called enzymatic structural material (ESM). It is designed to be strong, long-lasting, and recyclable, while requiring far less energy to make than traditional construction materials. The research team created ESM using an enzyme that helps turn carbon dioxide into solid mineral particles. These particles are then bonded together and cured under gentle conditions. The process allows the material to be shaped into structural components within hours. Conventional concrete must be produced at very high temperatures and can take weeks to fully cure. In contrast, ESM forms quickly and leaves a much smaller environmental footprint. ESM combines fast curing with adjustable strength and full recyclability. These qualities make it well suited for practical applications such as roof decks, wall panels, and modular building systems. The material can also be repaired, which may lower long-term construction costs and significantly reduce how much waste ends up in landfills. Beyond standard construction, the material could support affordable housing, climate-resilient infrastructure, and disaster recovery efforts. Lightweight components that can be produced quickly may help speed rebuilding after extreme events. Because ESM relies on low-energy manufacturing and renewable biological inputs, it also supports broader goals tied to carbon-neutral infrastructure and circular manufacturing systems.

Source https://www.sciencedaily.com/releases/2026/01/260121034148.htm

2. Scientists May Have Found the Holy Grail of Quantum Computing

Researchers from Norwegian University of Science and Technology (NTNU) believe they've found signs of a rare triplet superconductor, a material that could send both electricity and spin signals with zero energy loss. Such a breakthrough could pave the way for ultra-fast quantum computers that run on almost no power. Scientists believe so called triplet superconductors could open the door to the most energy efficient technologies ever developed. Researchers around the world are eager to confirm the existence of such materials. If verified, the finding would represent a major step forward for quantum science. The research focuses on quantum materials and their potential use in spintronics and advanced quantum devices. Spintronics relies on spin, a fundamental property of electrons, to carry and process information in ways that differ from today's conventional electronics. Spin can also play an important role in quantum technology, especially when paired with superconductors. However, one of the biggest obstacles has been instability. Traditional superconductors allow electricity to flow without measurable resistance. In practical terms, this means electrical current can move without losing energy as heat. While extremely useful, conventional superconductors have limitations. Conventional superconductors are known as 'singlet superconductors'. In simple terms, this means the superconducting particles do not carry spin. Triplet superconductors are different because their superconducting particles do carry spin. So why does that matter? "The fact that triplet superconductors have spin has an important consequence. We can now transport not only electrical currents but also spin currents with absolutely zero resistance," explained a researcher Linder. That ability could make it possible to transmit information using spin without any energy loss. In turn, extremely fast computers could operate using almost no electricity at all. The researchers demonstrated that the material NbRe exhibits properties consistent with triplet superconductivity. NbRe is a niobium-rhenium alloy, and both elements are rare metals. Their experimental research demonstrates that the material behaves completely differently from what we would expect for a conventional singlet superconductor. Another advantage of this material is that it superconducts at a relatively high temperature. Here, 'high temperature' refers to 7 Kelvin (K), just above absolute zero at -273.15 degrees Celsius. In the world of superconductivity, that is comparatively warm. Other potential triplet superconductors require temperatures close to 1K, making 7K far more practical and attainable. Taken together, the findings from NTNU suggest that the long sought triplet superconductor may finally be within reach.

SOURCE https://www.sciencedaily.com/releases/2026/02/260221000252.htm

Mechanical Engineering

3. **MIT just made Aluminum 5x Stronger with 3D Printing**

MIT engineers have created a new aluminum alloy that can be 3D printed, tolerates extreme heat, and reaches strength levels far beyond conventional aluminum. Tests show the material is five times stronger than aluminum made using standard manufacturing techniques. The alloy is produced by combining aluminum with several other elements, chosen through a process that blends computer simulations with machine learning. This approach dramatically narrowed the search for the right recipe. Traditional methods would have required evaluating more than 1 million possible material combinations, but the machine learning model reduced that number to just 40 promising options before identifying the optimal formula. When the researchers printed the alloy and put it through mechanical testing, the results matched their predictions. The printed metal performed on par with the strongest aluminum alloys currently produced through traditional casting. The team believes the new printable aluminum could lead to stronger, lighter, and more heat-resistant components, including fan blades for jet engines. Today, those blades are typically made from titanium -- which is more than 50 percent heavier and can cost up to 10 times more than aluminum -- or from advanced composite materials. The class focused on using computational simulations to design high-performance alloys. Alloys are made by combining multiple elements, and the specific mix determines strength and other key properties. Aluminum's strength depends heavily on its microstructure, particularly the size and density of tiny internal features called "precipitates." Smaller, more closely packed precipitates generally result in a stronger metal. Students used simulations to test different combinations of elements and concentrations, attempting to predict which mixtures would produce the strongest alloy. Despite extensive modeling, the effort did not outperform existing printable aluminum designs. That outcome prompted researchers to consider a different approach. In the new study, the team applied machine learning methods to search for a stronger aluminum alloy. These tools sifted through data on elemental properties to uncover patterns and relationships that traditional simulations often miss. By analyzing only 40 candidate compositions, the machine learning system identified an alloy design with a much higher proportion of small precipitates than previous attempts. This structure translated directly into greater strength, surpassing results obtained from more than 1 million simulations conducted without machine learning. To actually create the alloy, the researchers turned to 3D printing rather than conventional casting, which involves pouring molten aluminum into a mould and allowing it to cool slowly. Longer cooling times allow precipitates to grow larger, which reduces strength. The team showed that additive manufacturing, also known as 3D printing, allows the metal to cool and solidify much faster. They focused on laser bed powder fusion (LBPF), a process in which layers of metal powder are selectively melted by a laser and rapidly solidify before the next layer is added. This rapid freezing preserves the fine precipitate structure predicted by the machine learning model. To validate their design, the researchers ordered a batch of printable metal powder based on the new alloy formula. The powder -- made from aluminum combined with five additional elements -- was sent to collaborators in Germany, who printed small test samples using their LPBF equipment. Those samples were then shipped back to MIT for mechanical testing and microscopic analysis. The results confirmed the machine learning predictions. The printed alloy was five times stronger than a cast version of the same material and 50 percent stronger than aluminum alloys designed using conventional simulations alone. Microscopic imaging revealed a dense population of small precipitates, and the alloy remained stable at temperatures up to 400 degrees Celsius -- an unusually high threshold for aluminum-based materials. The research team is now applying the same machine learning techniques to refine other properties of the alloy.

Source https://sciencedaily.com/releases/2025/12/251226045316.htm

Chemical Engineering

4. IIT Madras Researchers pioneer Green Method to recover valuable metals from Electronic Waste

Indian Institute of Technology Madras (IIT Madras) Researchers have developed an innovative, green, and sustainable method to recover valuable metals from electronic waste (e-waste) using environmentally-friendly solvents derived from natural compounds. This breakthrough could pave the way for safer and more eco-efficient e-waste recycling practices that protect the environment while supporting India's circular economy goals. E-waste, one of the fastest-growing waste streams globally, contains a wealth of recoverable metals such as copper, gold, and iron. Yet, conventional recycling methods rely on harsh chemicals that produce toxic effluents and often yield metals in impure forms requiring further processing. To overcome these challenges, the IIT Madras research team explored the use of deep eutectic solvents (DES) — special liquid mixtures made from biodegradable natural substances that can dissolve metals without harming the environment. In their study, the team developed a green solvent from thymol (derived from thyme) and capric acid, which effectively dissolved copper metal. The dissolved copper was then safely extracted using trisodium citrate, a non-toxic chemical, and subsequently used to synthesise copper nanoparticles — materials with significant industrial and technological applications. By adjusting the pH of the solution, the researchers could produce different forms of copper, such as copper oxide nanoparticles and pure copper metal. The process was also successfully extended to recover iron from real e-waste samples like printed circuit boards and copper sheets. Unlike conventional acid-based extraction techniques, this method is biodegradable, non-toxic, and water-efficient, generating no hazardous waste. Its ability to recover multiple metals and directly produce valuable nanomaterials makes it more versatile and sustainable than other existing approaches. This green recovery process can significantly reduce pollution and environmental damage caused by e-waste while minimizing the demand for virgin metal mining. For society, the innovation promises safer recycling systems, cleaner ecosystems, and efficient use of natural resources. Currently, the research has shown successful laboratory-scale results, validating its potential across multiple metals and real e-waste samples. The next phase will focus on scaling up the process for industrial applications, improving solvent recyclability, and testing cost-effective alternatives to enhance economic viability. IIT Madras is also exploring collaborations with industry and recycling companies for pilot-scale implementation, with possibilities of technology transfer and licensing to enable real-world adoption.

Source https://www.iitm.ac.in/happenings/press-releases-and-coverages/iit-madras-researchers-pioneer-green-method-recover

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Electrical Engineering

5. New Super-Capacitor to Provide Electric Vehicles with Increased Range and Faster Acceleration

Researchers achieve record 3.4-volt performance using graphene-based electrodes, enhancing energy density and durability. Scientists have developed a high-voltage super-capacitor, which is a high-capacity, electrochemical energy storage device, that can facilitate applications like solar panels and also provide electric vehicles with increased range and faster acceleration. Conventional electrolytes used in commercial super-capacitors can operate between 2.5-3.0 volts and begin to decompose or face safety issues such as flammability at higher voltages. Bridging the gap between conventional capacitors and rechargeable batteries, they store energy electrostatically via ions on high-surface-area electrodes, enabling incredibly fast charging and discharging, high power density and a long lifespan of millions of cycles. Researchers at the International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), used dual-functional porous graphene carbon nanocomposite (PGCN) electrodes to reach an unprecedented 3.4 volts overcoming the 3.0-volt limitation of conventional super-capacitors along with significantly improved energy storage. “This innovation addresses electrolyte instability, doubling energy density to provide electric vehicles with increased range and faster acceleration while simplifying module design through reduced cell stacking,” a statement read. The enhanced performance originates from the engineered surface of the PGCN material, which is both water-repellent and highly compatible with organic electrolytes. This dual functionality suppresses water-induced degradation and enables rapid electrolyte penetration into the porous structure, improving ion transport and electrochemical efficiency. As a result, the super-capacitor delivers 33 percent higher energy storage, high power output, and excellent long-term stability, making it suitable for electric vehicles, grid-scale storage, and portable electronics, according to the researchers. The higher operating voltage reduces the need for stacking multiple low-voltage cells, enabling more compact and efficient energy-storage modules. The PGCN electrodes are produced through an eco-friendly process. Conducted at 300 degrees Celsius for 25 hours in a sealed vessel, the process eliminates the use of harsh chemicals and external gases, minimizes environmental impact and is scalable from laboratory to industrial production. “Consistent performance is ensured through precise control of synthesis parameters. Compared with commercial carbon-based electrodes, the PGCN electrode simultaneously enhances operating voltage and power output. PGCN-based super-capacitor stores 33 percent more energy than conventional devices and retains 96 percent of its performance after 15,000 charge-discharge cycles, demonstrating exceptional durability,” the researchers said. The research supports India’s clean energy goals and self-reliance initiative by strengthening indigenous capabilities in advanced energy-storage technologies a statement said.

Source https://www.tribuneindia.com/news/science-technology/new-super-capacitor-to-provide-electric-vehicles-with-increased-range-and-faster-acceleration/

Electronics and Communication Engineering

6. New lead-free device offers better performance for consumer electronics and security systems

Scientists have developed a novel lead-free, eco-friendly photo-detector with self-powered operation that delivers strong and stable performance that can be useful for consumer electronics, industrial monitoring, security systems and biomedical imaging. Modern cameras, environmental sensors and smart wearables rely on photo-detectors, the devices that convert light into electrical signals. Many high-performance versions currently utilise lead-based materials, which raise toxicity concerns and degrade easily in real-world conditions. To overcome this drawback, researchers at the International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI) have developed a lead-free, eco-friendly photo-detector based on the crystal material called 'perovskite' that delivers strong and stable performance. Unlike conventional designs that rely on costly metal contacts and additional hole-transport layers, which often necessitate the use of glove boxes or vacuum fabrication tools, this device utilises low-cost carbon electrodes and is fabricated entirely at room temperature using a simple one-step coating method. The device architecture naturally supports efficient charge separation, enabling self-powered operation without any external voltage. The new photo-detector exhibits a strong response to visible light and demonstrates excellent reliability under practical operating conditions. "The device retained its responsivity for more than 60 days when stored under ambient conditions without encapsulation. With its simplified architecture and carbon electrode, it exhibits excellent photo-response and resilience under harsh conditions, demonstrating its potential in addressing the lead toxicity and stability issues in photo-detectors," the researchers said. The combination of a lead-free material system, simple ambient-processed fabrication, low-cost components and strong operational stability makes this technology highly attractive for consumer electronics, industrial monitoring security systems and biomedical imaging. It also aligns with India's goals in sustainable materials, green manufacturing and self-reliance in next-generation electronics.

Source https://www.tribuneindia.com/news/india/new-lead-free-device-offers-better-performance-for-consumer-electronics-and-security-systems/

7. ISRO Successfully Launches US AST SpaceMobile's BlueBird Block-2 Communication Satellite

The Indian Space Research Organisation (ISRO) on December 24, 2025 successfully launched a next-generation US communication satellite BlueBird Block-2 onboard its heaviest vehicle LVM3-M6 from Sriharikota in Andhra Pradesh. The launch took place from the Satish Dhawan Space Station at 8:55 AM Indian Standard Time. After a flight journey of about 15 minutes, the spacecraft Bluebird Block-2 was separated from the vehicle and it was successfully placed into its intended orbit. Speaking on the occasion, ISRO Chairman Dr V Narayanan has hailed the successful launch of the BlueBird Block-2 communication satellite of US-based AST SpaceMobile, calling it the heaviest satellite ever lifted from Indian soil using an Indian launcher. He highlighted that the satellite was injected into its intended orbit with precision, marking a significant achievement for ISRO. The Bluebird Block-2 mission is part of a global LEO (Low Earth Orbit) constellation to provide direct-to-mobile connectivity through satellite. This constellation would enable 4G and 5G voice and video calls, texts, streaming and data for everyone, everywhere at all times. The mission was undertaken as part of the commercial agreement signed between NewSpace India Ltd (NSIL) and US-based AST SpaceMobile (AST and Science, LLC). NewSpace India Ltd is the commercial arm of ISRO. The LVM3-M6 is the sixth operational flight of LVM3 and the third dedicated commercial mission to launch the Bluebird Block-2 spacecraft. The LVM3 has a spectacular pedigree of completing eight consecutive successful launches, including the ambitious Chandrayaan-2 and Chandrayaan-3 missions.

Source https://www.newsonair.gov.in/isro-to-launch-bluebird-block-2-satellite-on-lvm3-m6-mission-today/

Mining, Metallurgical and Materials Engineering

8. CeNS Develops Advanced Cathode to Boost Grid-Scale Renewable Energy Storage

In a major advancement for sustainable energy storage, researchers have developed a novel cathode material that significantly enhances the performance and stability of aqueous zinc-ion batteries (AZIBs), potentially strengthening large-scale renewable energy integration. Scientists from the Centre for Nano and Soft Matter Sciences (CeNS), Bengaluru—an autonomous institute under the Department of Science and Technology (DST)—have synthesised sulphur vacancy-induced 1T-phase Molybdenum Disulfide (1T-MoS_2), a material that could address long-standing challenges in zinc-based battery systems. Aqueous zinc-ion batteries, which use water-based electrolytes, are considered safer, cost-effective, and environmentally friendly alternatives for storing renewable energy from solar and wind sources. Zinc metal, used directly as the anode, offers high theoretical capacity and abundant availability. However, the lack of durable, high-capacity cathode materials has limited their commercial scalability. The research team employed a controlled hydrothermal synthesis process to develop sulphur-deficient 1T-phase MoS_2 nanoflakes. The metallic-phase material exhibits high surface area and improved electrical conductivity, enabling faster electrochemical reactions and enhanced charge storage capacity. A key highlight of the study was the optimisation of the battery's electrochemical potential window. The team identified an ideal operational range between 0.2 and 1.3 volts (vs. Zn^{2+}/Zn), ensuring stable performance and improved durability. Performance testing revealed that the fabricated zinc-ion battery retained 97.91% of its initial capacity after 500 continuous charge-discharge cycles at a current density of 1 A g^{-1}. It also demonstrated a Coulombic efficiency of 99.7%, reflecting highly reversible zinc-ion insertion and extraction with minimal side reactions. The researchers successfully powered a commercial LCD timer using a coin-cell prototype, highlighting its practical applicability. The breakthrough is expected to accelerate the development of affordable, safe, and efficient battery systems capable of storing large volumes of renewable energy for grid-scale applications.

Source https://solarquarter.com/2026/02/20/cens-develops-advanced-cathode-to-boost-grid-scale-renewable-energy-storage/

Energy Engineering

9. Scientists develop single-unit device to capture, save solar energy

Scientists at the Department of Science and Technology (DST) have developed a solar-powered energy storage device that can both capture and store energy in a single unit, marking a major step towards clean, self-sustaining storage systems. Unlike conventional solar systems that require separate units for energy harvesting and storage, the new technology can do both functions, reducing cost and energy losses during conversion, it said. The device known as photo-rechargeable supercapacitor was developed by researchers at the Centre for Nano and Soft Matter Sciences, Bengaluru under DST. The new technology paves way for efficient, low cost, and eco-friendly power solutions for portable, wearable, and off grid technologies, it said. Conventional hybrid systems relied on additional power management electronics to regulate voltage and current mismatches between the energy harvester and the storage unit. The resultant system complexity and device footprint was detrimental for miniaturized and autonomous devices, the statement said. The innovation used the help of binder-free use of nickel-cobalt oxide (NiCo2O4) nanowires, which have been uniformly grown on nickel foam using a simple in situ hydrothermal process. “These nanowires, only a few nanometres in diameter and several micrometres long, form a highly porous and conductive 3D network that efficiently absorbs sunlight and stores electrical charge. This unique architecture allowed the material to act simultaneously as a solar energy harvester and a supercapacitor electrode,” as said in the statement issued. When tested for real-world applications, the device delivered a stable output voltage of 1.2 volts, maintained 88 per cent of its capacitance retention even after 1,000 photo-charging cycles. Further, it operated efficiently under varying sunlight conditions-from low indoor illumination to intense sunlight. This stability indicates that the nanowire structure can endure both mechanical and electrochemical stress over extended periods of use, the statement noted. The self-charging power system can function anywhere even in remote regions without access to an electrical grid and can substantially reduce dependence on fossil fuels and conventional batteries.

Source https://www.thehansindia.com/hans/young-hans/scientists-develop-single-unit-device-to-capture-save-solar-energy-1044802

Interdisciplinary and Special Engineering Fields and Leadership in Academia, R&D and Industry

10. IIT Madras develops ramjet-assisted Artillery Shells to extend gun range without compromising lethality

Indian Institute of Technology Madras (IIT Madras) researchers have successfully developed and tested ramjet-propelled artillery shells designed to dramatically extend the range of conventional gun systems. This marks a significant milestone in the indigenous development of defence technology. The IIT Madras innovation integrates a ramjet engine into an existing 155 mm artillery shell, replacing the conventional base-bleed unit. Unlike rocket-assisted projectiles or incremental aerodynamic improvements, this approach enables sustained propulsion after the shell exits the barrel, significantly extending its reach while preserving the shell's destructive effectiveness on target. A ramjet is a type of engine that uses the vehicle's high speed to compress incoming air, mix it with fuel, and generate thrust without moving parts like turbines. In artillery systems, ramjets allow shells to travel much farther after being fired, extending range without changing the gun itself. This gives armed forces greater reach and flexibility while keeping costs and complexity low. The research addresses one of the most persistent challenges in modern artillery — increasing firing range without sacrificing mobility, deployability or lethality. While missiles offer long-range strike capability, they are expensive and complex. Artillery guns remain the backbone of battlefield firepower due to their simplicity, survivability and cost-effectiveness, but have traditionally faced hard technological limits on range. The researchers said "If fully realised, this technology could allow Indian artillery units to engage targets at nearly 50 % more distances, offering commanders greater tactical flexibility, deeper strike options and enhanced deterrence — without the need for new gun platforms or costly missile systems. Importantly, the design ensures that the extended range does not dilute battlefield impact, maintaining the lethality required for frontline operations. As expressed the same technology when adopted to rockets can enhance the range significantly. Some projects in this direction are already underway. The project, initiated in 2020 in collaboration with the Indian Army, has progressed through multiple stages of testing. Early trials using a 76 mm gun developed at IIT Madras validated the core concept, followed by scaled testing on 155 mm artillery guns. Subsequent trials conducted in September 2025 at the School of Artillery, Deolali, successfully demonstrated clean gun exit, stable flight and ramjet ignition, validating both internal and external ballistics. Further field trials in December 2025 at the Pokhran Field Firing Range marked another critical step, with the shell exiting the gun cleanly at higher operational zones. Ongoing refinements are addressing remaining technical challenges, paving the way for full operational capability.Beyond defence applications, the project showcases the potential of indigenous, mission-driven research to deliver real-world outcomes. By reimagining how existing systems can be upgraded rather than replaced, IIT Madras's work offers a scalable and cost-efficient pathway for modernising artillery forces. The ramjet artillery programme stands as a compelling example of how academic innovation, when closely aligned with operational needs, can directly strengthen national security and position India at the forefront of global defence research.

Source https://www.iitm.ac.in/happenings/press-releases-and-coverages/iit-madras-develops-ramjet-assisted-artillery-shells-extend

Back to Main Page

ENGINEERING INNOVATION IN INDIA

1. IIT-M researchers develop VR tool to quantify surgeons' laparoscopic skills

Researchers at IIT Madras developed a tool to objectively measure how well surgeons performed laparoscopic, or keyhole, procedures - a breakthrough that could standardise how surgical skills are taught and tested. Laparoscopic surgery, commonly used for gallbladder removals and bariatric weight-loss operations, presents unique challenges. Surgeons operate through tiny incisions using long instruments, watching their movements on a monitor. This limits tactile feedback, complicates depth perception, and inverts hand movements due to the fulcrum effect -tiny cut in the skin acts like a seesaw pivot. Traditional training programmes relied on subjective evaluation tools to help surgeons overcome these hurdles. Though structured, these methods depend heavily on an instructor's judgement, leading to variability in scoring precision, efficiency, tissue handling, and overall competence. The IIT team took another approach, drawing on computer science principles. They applied Fitts' Law - a concept from human-computer interaction that predicts movement time based on a target's distance and size - to design a custom VR haptic (touch) simulator. This system replicates laparoscopic conditions, including inverted visuals, and quantifies performance metrics such as movement time and throughput during standardised tapping tasks. Scientists tested the model on 24 young surgeons and found that inverted tool visuals increased movement time by average of 11.86% compared to non-inverted movement. The VR method addresses training hurdles - the fulcrum effect, reduced touch feedback, and mirror (reversed) movements -outperforming subjective systems by providing consistent, data-driven scores. The research bridges computer science, engineering and neurosurgery, setting the stage for global adoption of standardised VR assessments that could revolutionise minimally invasive training worldwide. With surgeon shortages and rising demand for minimally invasive procedures, this innovation could accelerate skill development, reduce training costs, and improve patient safety, said researchers.

Source: https://timesofindia.indiatimes.com/city/chennai/iit-m-researchers-develop-vr-tool-to-quantify-surgeons-laparoscopic-skills/articleshow/128273491.cms

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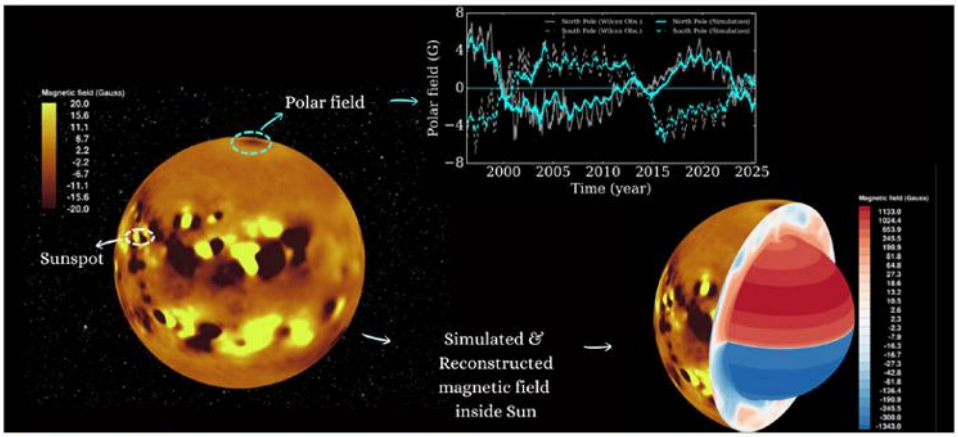
2. Researchers at IIT Kanpur map the magnetic field inside the Sun

Researchers at IIT Kanpur map the magnetic field inside the Sun for the first time by combining 30 years of surface observational data from space satellites into a 3D computational model. This study provides an unparalleled estimate of the magnitude, structure, and evolution of magnetic fields inside the Sun over three decades, which is tremendously important for understanding how our Sun drives space weather that disrupts satellites, radio communication, navigation, and technological assets. Understanding solar magnetic activity is essential for explaining and predicting space-weather events that can disrupt satellites, power grids, navigation, and communication systems on Earth. This activity does not remain constant: it rises and falls roughly every 11 years, following a regular magnetic cycle that governs the appearance of sunspots and solar eruptions.

The physical mechanism behind this cyclic behaviour is the solar dynamo - a process through which the Sun generates its magnetic field deep within its interior. Since this region lies hidden beneath the solar surface, scientists cannot observe it directly. Although modern instruments can measure the solar surface magnetic field in unprecedented detail, the inaccessibility to probe the solar interior has long limited efforts to estimate the magnitude and behaviours of the magnetic field inside the Sun. The unavailability of a proper estimate of the solar magnetic field inside the Sun is one of the major bottlenecks to testing and refining theories of how the solar dynamo operates.



A recent study led by Soumyadeep Chatterjee, a PhD student, together with his supervisor Prof. Gopal Hazra from the Department of Physics, IIT Kanpur, takes a step towards addressing this challenge. The researchers developed a three-dimensional dynamo model that assimilates a huge amount of long-term observational data of the solar surface magnetic field for three decades. Combining all 30 years of surface magnetic field data into a 3D computational model, the study examines how large-scale, average magnetic patterns evolve over time and map the entire three-dimensional magnetic field inside the Sun. The idea is that if magnetic fields deep inside the Sun play a dominant role in shaping surface magnetism, then traces of these internal fields should persist in surface observations collected over long periods.

One of the key strengths of this approach is its strong reliance on observations rather than purely theoretical simulations. By anchoring their model to real data, the researchers are able to place meaningful constraints on the magnitude, structure, and evolution of magnetic fields beneath the solar surface. The model is validated using observations of the solar polar magnetic field - a widespread field near the poles that is known to provide an important indication of the strength of the next solar cycle.

The researchers further suggest that their approach is very robust for predicting the peak of the next solar cycle and much more realistic than any other predictive models of the solar cycle. This study also shows that the computational model combined with big observational data is the future of the field, and it is extremely important to improve long-term planning to protect space missions and technologies against solar activity.

Source https://www.iitk.ac.in/reveal-sun-mysterious-magnetic-interior

Note: *Fellows are requested to forward their achievements/achievements of their organziation to be featured under the heading "Engineering Innovation in India".*

Back to Main Page