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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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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

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 be 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 of residence (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.

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ACADEMY ACTIVITIES ACADEMY NEWS

Academy News (Covering period from January 1, 2023 to March 31, 2023)

EVENTS (held between January 1, 2023 to March 31, 2023)

Joint Activities with SERB.

I. SERB-INAE Collaborative Initiative in Engineering

INAE jointly with SERB had taken a new initiative last year to conduct various events under SERB-INAE Collaborative Initiative in Engineering. As an outcome, the following four initiatives under the umbrella of 'Collaborative Initiative in Engineering' were organized during this year.

- a. SERB-INAE Conclaves on *Atmanirbhar* Technologies - Engineering Secured Future
- b. SERB-INAE Woman Engineers Program
- c. SERB-INAE Outreach Programs for NE, J&K and Ladakh
- d. SERB-INAE Innovation Hackathon

INAE has received a tremendous response and the initiative has progressed well with the conduct the above listed events efficiently under all the four verticals. In this regard, the events/programs had been organized during the Quarter January to March 2023 under the umbrella of 'Collaborative Initiative in Engineering' as given below:

a) SERB-INAE Conclaves on *Atmanirbhar* Technologies - Engineering Secured Future

Last event held in during November 5-6, 2022 at IIT Kanpur and covered in last issue of e-Newsletter.

b) SERB-INAE Woman Engineers Program

SERB-INAE Workshop on "Writing R&D Grant Proposal for Women Engineers" held at IIT Gandhinagar on 23-24 February 2023

SERB-INAE Workshop on "Writing R&D Grant Proposal for Women Engineers" was organized at IIT Gandhinagar on 23-24 February 2023. Dr DR Prasada Raju, FNAE and Dr RK Tayal, FNAE were the Coordinators of the event from INAE. The workshop was aimed at women faculty and researchers in engineering from less privileged engineering and technological institutions/universities in Goa, Gujarat, Madhya Pradesh, Maharashtra, and Rajasthan. The workshop was organized with the objective of encouraging women engineers across the country to undertake research and pursue funding for their research proposals. The engineers who attended the workshop were provided with valuable insights on research funding, evaluation of research grants, and other related aspects. The funding agencies' role, various types of research grants, the contents of the proposal, the formulation of proposal, ways of defending a research grant, and implementation of research grants were some of the topics covered during the workshop. Women faculty/researchers working at a State-level (public/private) Engineering/Technological Institutes or Universities from the states of Goa, Gujarat, Madhya Pradesh, Maharashtra and Rajasthan participated in this workshop.



Dignitaries Lighting the Lamp

During the opening session, Professor Sivaji Chakravorti, Vice-President, INAE and Professor, Electrical Engineering Department, Jadavpur University, Kolkata, emphasized the inter-connectedness of teaching and research. He also highlighted the importance of encouraging women engineers to conduct research in order to bridge the gender gap. To do so, it is essential to secure funding. Prof. Atul Bhargav, IIT Gandhinagar and Prof. Amit Prashant, Dean R&D, IIT Gandhinagar also participated in the inauguration ceremony. Prof. Jhuma Saha, Assistant Professor, Electrical Engineering, IIT Gandhinagar gave some useful insights on grant writing. She emphasized the importance of grant writing for research projects. Her remarks were relevant to the researchers who are seeking funding for their projects, and it helped them to understand the intricacies involved in the grant writing process.



Workshop on "Writing R&D Grant Proposal for Women Engineers" Proceedings in Progress

Overall, the participation of eminent personalities in the workshop added value to the proceedings and provided deep understanding to the participants. As part of the event, a book called "Research Insights," written by Dr. Rajiv K Tayal, formerly Adviser/Scientist 'G', of DST and a resource person for the workshop, was launched. Dr. RK Tayal gave a comprehensive talk on scientific Research and Development during the workshop. He began by discussing the classification of research and the importance of research in academics. He also emphasized the significance of good research and the qualities that define it. He then moved on to detail the essentials required for research, including funding options and extramural research grants. He elaborated on the different types of grants and their contents. He also covered the key elements that should be included in a grant proposal and provided insights on how to write a compelling proposal. Dr. Tayal also spoke about the rebuttal process, presentation, and discussion phases of a grant proposal. He highlighted the importance of making sense of the information and picking up leads during the research process. Overall, Dr. Tayal's talk provided valuable insights and an understanding into scientific research and development, and it was well-received by the workshop attendees. His expertise in the field added value to his talk which served as an excellent guide for those looking to pursue research.



Group Photograph of Participants with Dignitaries during Workshop on “Writing R&D Grant Proposal for Women Engineers”

During the one and a half-day workshop, Professor Sivaji Chakravorti and Dr. DR Prasada Raju delivered lectures on project-based learning and available funding opportunities, respectively. In addition to the technical sessions, the workshop also included several group activities aimed at building confidence among women engineers in crafting compelling R&D grant proposals for government agencies. An industrial visit was organized to Sahajanand Laser Technology Ltd during which the participants were provided with a detailed tour of the company's manufacturing unit, research and development facility, and quality control labs. Sahajanand Laser Technology Ltd is a renowned company that has been providing cutting-edge solutions for metal forming operations for more than three decades. The visit highlighted the importance of innovation and technology in the manufacturing industry, and how it can help to improve efficiency and productivity. Overall, it was a valuable learning experience for all the participants.



Highlights of the Workshop on “Writing R&D Grant Proposal for Women Engineers”

The distribution of mementos to all the speakers by Prof Atul Bhargav at the end of the workshop was a great gesture of appreciation and recognition for their contribution to the workshop. It was a moment of gratitude and acknowledgement for the speakers who shared their knowledge and expertise with the participants. The workshop was an outstanding success in meeting the laid down objectives.



Group Photographs during the Workshop on “Writing R&D Grant Proposal for Women Engineers”

c) SERB-INAE Outreach Programs for NE, J&K and Ladakh

Science and Technology Exhibition 2023 at NIT Manipur

The Science and Engineering Research Board (SERB) and Indian National Academy of Engineering (INAE) jointly organized two-day “**Science and Technology Exhibition**” in association with National Institute of Technology, Manipur on February 1-2, 2023. This workshop focused on the Prototype model display and discussion from students at the level of UG, PG and PhD from all NITs in the North Eastern Region of India and Institutes/Colleges/Universities in Manipur State. The following were the objectives of the event (a) To promote the innovative ideas of the students in UG, PG and PhD (b) To encourage the students for developing the prototype models (c) To develop the scientific and technological knowledge of the participants.

The function was graced by Prof. Sivaji Chakravorti, Vice President of INAE as Chief Guest, Prof. S Venugopal Director, NIT Nagaland as the Guest of Honour, and Prof. Goutam Sutradhar, Director of NIT Manipur as the President of the inaugural function delivered the Presidential Address. A total of eighteen models or prototypes were presented by eighteen teams comprising 66 participants and 16 mentors in the diverse domains of Artificial Intelligence, Geographical Information System, Hydro-power, Environmental Impact Assessment etc. Various colleges or universities from Manipur, NIT Arunachal, and NIT Nagaland participated in the exhibition. The ideas and the models were focused on feasibility and market demand. The demonstrated ideas or models were highly appreciated by the dignitaries and the judges. The first and the second prizes were bagged by NIT Manipur and, Kamakhya Pemton College of Manipur won the third prize. Ten achievement prizes were awarded to the teams from various institutions participated for their innovative ideas.



Lamp lighting ceremony for “Science and Technology Exhibition” at NIT Manipur



Prof Shivaji Chakravorti, Chief Guest addressing the audience on the occasion of “Science and Technology Exhibition” at NIT Manipur



Group photograph of the prize winners for their innovative ideas at NIT Manipur

d) SERB-INAE Innovation Hackathon

Last event held during 3-4 September 2022 at Jadavpur University, Kolkata and covered in October 2022 issue of e-Newsletter.

II. SERB-INAE Digital Gaming Research Initiative

The SERB-INAE Online and Digital Gaming Research Initiative was launched to leverage Digital Gaming Research and Industry in India and to achieve self-reliance in advanced Augmented Reality (AR)/ Virtual Reality (VR) technologies to create indigenous gaming platforms for a number of applications ranging from education to leisure with the backdrop of Indian Ethos, for desktop and hand-held devices. A Letter of Intent was signed by INAE with SERB during March 2022. A call for well-defined proposals on the following thematic areas concerning online and digital games were invited through INAE Website and was also published in Indian Express (pg 27 on October 13, 2022) and Hindustan Times (pg 8 on October 13, 2022), besides forwarding to INAE Fellows, Young Associates, Directors of

IITs, NITs and CFTIs and AICTE for further distribution. The call for proposals was open from October 10, 2022 till December 15, 2022.

- **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**

Proposals were particularly invited from:

- Scientists in regular service from educational and research institutes / laboratories/ universities, start-ups and industries. More than one academic partner was allowed.
- Ideally from a consortium and should be an industry-academy (including start-ups) collaboration with IP creation as a priority.
- Investigators already having a SERB project.
- Multidisciplinary teams involving technologists, designers, historians and experts in other areas of humanities and social sciences were encouraged for the project.

Forty-three proposals have been received which would be selected for execution shortly based on the merit of the proposal and guidelines thereof. The number of proposals received under each category are as given below:

- Category (I): R&D in Learning, Educational, and Leisure Online Gaming Platforms --17 proposals
- Category (II): Immersive Game Prototypes, with a focus on Indian Culture & Values --15 proposals
- Category (III): Collaborative Technical Design Process: Creation of SERB Game Labs—11 proposals

Out of total 43 proposals received, twelve proposals were provisionally ineligible and one duplicate proposal was received. INAE is to circulate the list of 43 proposals received and verify with the PIs of twelve provisionally ineligible proposals in case they can provide supporting document(s) to make their proposal eligible to be considered for evaluation. In order to have the common understanding for effective evaluation of the proposals received, a meeting of Program Management Advisory Committee (PMAC) for SERB-INAE Online and Digital Gaming Research Initiative was convened on April 6, 2023 in hybrid mode. The proposals shall be selected by the concerned experts from SERB and INAE shortly based on the methodology to be suggested during the meeting.

III. Joint INAE-SERB Scheme to Promote Translational Research in Engineering

INAE -SERB Abdul Kalam Technology Innovation National Fellowship

Indian National Academy of Engineering (INAE) and Science and Engineering Research Board (SERB), Department of Science and Technology (DST) had launched the INAE-SERB, DST Abdul Kalam Technology Innovation National Fellowship in the year 2017 to recognize, encourage and support translational research by Individuals working in various capacities of engineering profession, in public funded institutions in the country. Ten Fellows were selected in this FY 2022-23. At present, 45 fellows are functional under the scheme and the work done by these fellows have reached the stage of technology transfer to start-ups and strategic areas to include 53 patents being filed/granted so far. As per the guidelines of the fellowship, the duration of the Fellowship will be initially for three years, extendable by up to two more years depending on the performance. The fellowship can be held for a maximum of 5 years. All fellowships are reviewed on completion of three years, and if the progress is found to be in line with the proposal, an extension of additional two years is granted to the fellow. The performance of seven fellowships completing their tenure of three years on January 31, 2023 were reviewed by the Search Cum Selection Expert Committee (SSEC) during its meeting held on December 2, 2022 in hybrid mode, 7 existing Fellows were recommended for extension of tenure of Fellowship by

another two years. The call for nominations is open and being invited with the last date for the receipt of nominations being June 30, 2023. The call for nominations has been posted on INAE Website and can be viewed at the link <https://www.inae.in/abdul-kalam-technology-innovation-national-fellowship/>

Advertisements inviting nominations for the subject fellowship were also placed nationwide in newspapers such as Times of India in the following editions - New Delhi, Visakhapatnam, Panaji, Ahmedabad, Thiruvananthapuram, Bhubaneswar, Jaipur, Chennai, Hyderabad and Kolkata; Hindustan Times, Mumbai edition and Tribune, Chandigarh edition on April 23, 2023. Advertisements were also placed in leading Hindi Newspapers such as Navbharat Times, Raipur edition; Hindustan, Delhi edition besides several others. An advertisement can be viewed by [clicking here.....](#)

Local Chapter Activities and Webinar Series held during January 2023 to March 2023

The following Webinars/activities/meetings/Technical Lectures were conducted during January to March 2023 by INAE and Local Chapters.

- Two Technical Talks by INAE Delhi Chapter viz., (i) Talk on "Who protects the Unprotected? ITS Services for Vulnerable Road Users" by Professor Claudio Casetti, Professor at Department of Control and Computer Engineering, Politecnico di Torino, Italy; and (ii) Talk on "Deployment and Management of Edge Microservices" by Prof. Carla Fabiana Chiasserini, Professor at Politecnico di Torino, Italy, and a Research Associate with the Italian National Research Council (CNR) and the National Inter-University Consortium for Telecommunications(CNIT) jointly organized by INAE Delhi Chapter in association with Bharti School of Telecommunication Technology and Management, IIT Delhi and IEEE Vehicular Technology Society (VTS) Delhi Chapter on January 2, 2023. The Abstracts and Speaker's bio of both lectures can be viewed by [clicking here...](#)
- **Prof. Arun Kumar Choudhury Birth Centenary Symposium** on the theme "From Switching Theory to Quantum Computing" organized jointly by INAE Kolkata Chapter in collaboration with The Department of Computer Science and Engineering, University of Calcutta, and the A. K. Choudhury School of Information Technology of the University of Calcutta on January 8-9, 2023 to commemorate the birth centenary of Prof. A. K. Choudhury (1923-1987), who was an illustrious computer scientist in India during 1950-1980's. He pioneered research in several areas of electrical and computer engineering in India such as analog computers, circuit theory, control engineering, switching theory and logic design, VLSI circuit testing, and graph theory. Apart from teaching numerous undergraduate and graduate students, he mentored around 60 Ph.D. students, who subsequently became eminent in their respective fields. In 1980, he established the Department of Computer Science at the University of Calcutta. He had left an illustrious legacy behind, and an indelible mark of inspiration among the contemporaries, and in the minds of thousands of students he had taught.

The theme of the symposium was "From Switching Theory to Quantum Computing" that aptly reflects the wide scope of Prof. Choudhury's research work. The symposium was graced by several invited talks, student presentations, panel discussions, and reminiscences on the life and work of Prof. Choudhury as narrated by his former students and peers. The programme comprised of four technical sessions namely, Signals and Systems, Distributed and Mobile Computing, Next Era of Computing, and Smart CPS/IoT and Machine Learning, where distinguished speakers from academia and industry presented invited talks. Two interactive panel sessions were conducted: one on CSE Higher Education in India, and the other on Innovation and Entrepreneurship. In addition, several past students and colleagues of Prof. Choudhury spoke about their personal experiences and anecdotes in two special sessions on remembrances.

An exciting Poster Session on Students' Research Work had also been organized and the awards were sponsored by the INAE Kolkata Chapter. The research posters were selected from the submissions received from diverse institutions on a competitive basis. Prof. Debatosh Guha, FNAE, President of the INAE Kolkata Chapter, handed over the prize money and citations to the winners. A marble statue of Prof. A. K. Choudhury had been unveiled at the Department of Computer Science and Engineering, University of Calcutta, Salt Lake Campus, Kolkata, following the inaugural program of the symposium. Further details of the AKC100 Symposium and YouTube videos can be found at: <https://sites.google.com/view/akc100symp>



Prof. Arun Kumar Choudhury Birth Centenary Symposium -Group Photograph



Prof. Arun Kumar Choudhury Birth Centenary Symposium -Glimpses of Delegates

- Lecture organized by INAE Delhi Chapter jointly with Bharti School of Telecommunication Technology and Management, IIT Delhi, IEEE Vehicular Technology Society (VTS) Delhi Chapter and IEEE Comm Society on 17th January 2023 on “Cross-Sector Infrastructure Sharing: Synergy Between Telecom, Transport and Energy Sector” by Mr. Rajendra Singh, Senior Digital development Specialist, The World Bank. The Abstract and Speaker’s bio of the lecture can be viewed by [clicking here...](#)
- Webinar by INAE Chennai Chapter on 28th January 2023 on "Character in Globalization: Retaining dignity and individuality in a not so flat world of free-market and globalization" by Dr. Sathya Prasad Mangalaramanan, FNAE, Senior Vice President, Ashok Leyland, Chennai. The Abstract and Speaker’s bio of the lecture can be viewed by [clicking here...](#)

- A Webinar was organized by INAE Mumbai Chapter on 31st January 2023 on "Chemical Parks in India: Sparking a Game changer" by Shri Rajeev Pandia, FNAE, Former President, Indian Chemical Council. The moderator was Prof. AK Suresh, FINAE, Emeritus Fellow, Department of Chemical Engineering, IIT Bombay. The Abstract and Speaker's bio of the lecture can be viewed by [clicking here...](#)

The webinar presented the concept of chemical parks with examples in the global emerging economies. It further emphasized with examples on the present gaps in infrastructure in the Indian context. At present India with 17% of the world population has a mere 3% share in the global chemical industry while China with the same population has 33% share and this is projected to grow to 40% in the 2020s. There is a need for trade production measures in India since our imports are growing at a faster pace as compared to the exports. Examples were cited about Korea and Thailand where phenomenal progress was achieved using the Chemical Park concept. The scenario in India clearly highlights a lack of strategic planning.

The talk highlighted the need for suitable development of feedstock, power/water, and steam resources, and facilities such as, pipeline corridor, wastewater treatment, solid waste disposal, and transport infrastructure with good roads, rail tracks and river/sea routes. Development of a large number of chemical ports along the coastal regions was suggested for improving the transport infrastructure. Human resource and skill development, and R&D lab facilities around the chemical parks were also recommended. Examples of chemical parks that promoted phenomenal growth in various countries were cited during the webinar, including the Jurong-1.0 chemical park in Singapore, Rotterdam chemical park in Netherland, Belgium, France, Germany and Italy, Shanghai chemical park in China and South Korean chemical parks. Development of the Jurong-2.0 chemical park (Singapore) focussing on futuristic technologies with low carbon emission, and technologies with provision for carbon capture and chemical recycling were elaborated. In the Indian context the need for developing free quality stock, PPP growth models with emphasis on quality (abandoning the L1 concept) was emphasized. It was suggested that resurrection is still possible with suitable policy interventions and corrective steps. Implementation of circular economy concepts and introduction of hydrogen fuel as announced by the Indian Government are some of the approaches that can provide an impetus for development of cost effective and environment friendly technologies. The webinar talk was well conceived, and it was concluded that chemical parks can meet the future challenges of the Indian chemical industry and policy interventions can have a beneficial effect. The experts suggested organizing an INAE Conclave on Chemical Parks where various issues can be addressed and recommendations may be made to the Indian Government.

- INAE Kolkata Chapter in association with IEEE AP/MTTs Kolkata Chapter and its associated Student Branch Chapters organized a lecture meeting in the afternoon of February 15, 2023 at B. R. Nag Auditorium of Institute of Radio Physics and Electronics, Science College Rajabazar Campus of the University of Calcutta. Shri Tapan Misra, FNAE, Founding Director and Chief Scientist, SISIR Radar Pvt. Ltd, Kolkata was the sole speaker and he talked on 'Space Technology for the Last Mile Application'. In nearly one and half hour's session, Shri Mishra elaborately discussed utilization of remote sensing and IR-imaging in satellite-based systems to get high resolution images of the earth for geographical survey. The lecture was attended by about 100 students and researchers who assembled from different Universities and Engineering Colleges in and around the city. It created an enormous interest among them as revealed from a lively question-answer session. At the end of the event, there was a pleasant surprise for the attendees to win lucky draws which were conducted by Mrs. Arundhati Misra, former Group Director of SAC, ISRO and two of lucky attendees had won the prize. Prof. Debatosh Guha, Chair, INAE Kolkata Chapter presided over the function and Dr. Kaushik Mandal, Secretary, IEEE AP/MTTs Kolkata Chapter conducted the event.



Felicitation by an IEEE Volunteer



Shri Tapan Mishra addressing the audience



A group photo with some UG Engineering students

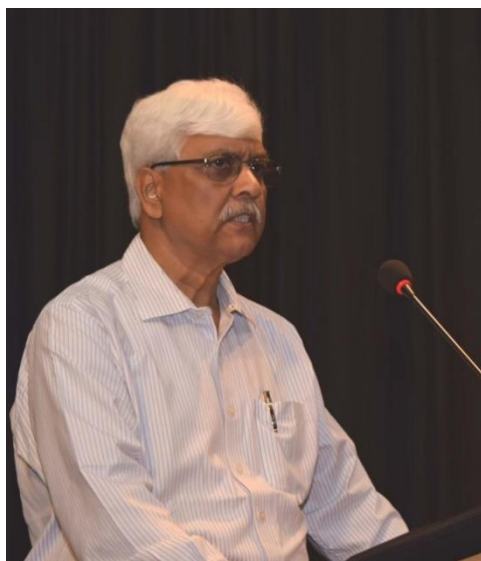
- Seminar by INAE Delhi Chapter on 17th February 2023 on "Advanced Packaging: Chiplets, Dielets, and Heterogeneous Integration" by Professor Dr Subramanian S. Iyer, Distinguished Professor and holds the Charles P. Reames Endowed Chair in the Electrical Engineering Department and a joint appointment in the Materials Science and Engineering Department at the University of California at Los Angeles (UCLA). He is Director of the Center for Heterogeneous Integration and Performance Scaling (UCLA CHIPS). The Abstract and Speaker's bio of the lecture can be viewed by [clicking here...](#)
- The 23rd Distinguished Lecture was organized by INAE Bhubaneswar Chapter on 27th February 2023 wherein Dr. Ashwini K. Nanda, Founder and CEO of HPC Links Pvt Ltd, in India and USA delivered a talk on "Applied Research in Computer Architecture, AI, and HPC - a Personal Journey"

Key Points: Discussion on the primary challenges of extreme-scale AI-coupled HPC campaigns -- task heterogeneity, adaptivity, performance -- and several framework and middleware solutions which aim to address them. While both HPC workflow and AI/ML computing paradigms are independently effective, the talk highlights how their integration, and ultimate convergence, is leading to significant improvements in scientific performance across a range of domains, ultimately resulting in scientific explorations otherwise unattainable. The presentation thoroughly explains an Exascale applications from the Autonomous Driving, Cancer Research which starts from molecular level to drug level modelling, diagnosis, patient tracking etc. and many more. The talk also covers the Proposed Integrated Labs and Industry 4.0 Focus. 45 people participated in the talk.

➤ **INAE Kolkata Chapter - National Science Day Celebration**

The Kolkata Chapter of Indian National Academy of Engineering (INAE) celebrated the National Science Day on March 1, 2023 at Dr J C Ray Auditorium of the Indian Institute of Chemical Biology (IICB), Jadavpur, Kolkata. Padma Shri Professor Sankar K Pal, National Science Chair, SERB, Govt. of India & President, Indian Statistical Institute and Dr. Arun Bandyopadhyay, Director, CSIR-Indian Institute of Chemical Biology (IICB) delivered Science Day lectures on this occasion. The function started at 3 PM and it was attended by more than 70 participants of different ages and interests including about 12 Fellows of the Academy. Prof. Sivaji Chakravorti, Vice-President, INAE presided over the function and gave the welcome address. Professor Sankar K Pal talked on ‘Pattern Recognition, Machine Intelligence to Data Science: Evolution and Challenges’ and shared a part of his personal journey as a researcher since early 1970s. He addressed the evolution of the subject and its growth over the time. The one-hour talk was truly exciting and motivating to the young engineers and scientists present in the audience.

The program was streamed online, and many participants could join the talks even from remote locations. It was followed by the second talk given by Dr. Bandyopadhyay which was based on some facts and philosophy of science. The title of his talk was “R&D is not Driven by Profit Alone”. He shared his experience and realization which he and his team gathered during the time of Covid 19 pandemic. He discussed how his research labs and scientists, apparently obscure to the common people, came to the forefront during the pandemic in saving lives and handling the grave situation in Kolkata and other places in West Bengal. Both lectures created huge interest among the participants as revealed from the question answer sessions. Prof. Debatosh Guha, Chair, INAE Kolkata Chapter conducted the proceedings of the meeting and offered the formal vote of thanks. He acknowledged the help and support received from the Director and staff of IICB in organizing the event in their premises. There was a provision for a lucky draw announced to encourage the participants and that was held at the end of event. Mr. Subhajit Maur, a student of Jadavpur University, had won the prize.



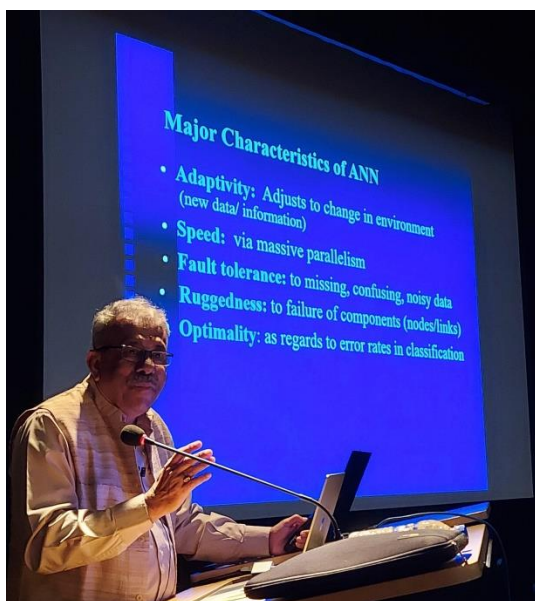
Prof. Sivaji Chakravorti welcoming the gathering



Prof. Sankar K Pal addressing the audience



The audience in Dr J C Ray Auditorium of the Indian Institute of Chemical Biology, Jadavpur, Kolkata



Prof. Sankar K Pal giving his talk



Dr. Arun Bandyopadhyay giving his talk



Token of appreciation for the speakers



Mr. Subhajit Maur won the lucky draw

- **INAE Women's Day Celebration talk at Electron Beam Centre, Navi Mumbai March 11, 2023.** Talks were held by INAE Mumbai Chapter on the theme "Women contributions in Engineering and Technology" on 11th March 2023 - (i) Smt Smitha Manohar, Director NRG, BARC & INAE fellow delivered talk on "Nuclear Fuel Recycling"; (ii) Dr Gopika Vinod, Fellow INAE delivered talk on "Reliability, safety & risk analysis on nuclear & non-nuclear facilities"; (iii) Dr (Smt) K. Umasankari, Head RPDD, BARC delivered talk on "Reactor Design"; and (iv) Smt. Anuradha Sharma, founder member and partner of Chromosome Consulting and IT services delivered talk on "corporate leadership".



INAE Mumbai Local Chapter Women's Day Celebration Lectures in Progress

As per the initiatives of INAE Mumbai Local Chapter, Women's Day 2023 function was organised with talk at EBC Navi Mumbai on March 11th 2023, Project Manager, EBC delivered an introduction talk on indigenous electron beam accelerator technologies developed at EBC, BARC. Prof. Archana Sharma, Director BTDG, BARC, introduced the Guest speaker Smt Smitha Manohar, FNAE, Director NRG, BARC to deliver talk on Nuclear Fuel Recycling. Sh. K. Jayrajan, Former Chairman BSC, BARC felicitated Smt Smitha Manohar by giving memento after the talk. Dr Gopika Vinod, FNAE delivered talk on Reliability, safety & risk analysis on nuclear & non-nuclear facilities & was felicitated with memento by Sh. Martin Mascarenhas, Head L&PTD, BARC. Dr (Smt) K. Umasankari, Head RPDD, BARC delivered talk on reactor design and was felicitated with memento by Smt Kavita Dixit, Former Head BSCS, BARC. Smt. Anuradha Sharma, founder member and partner of Chromosome Consulting and IT services gave talk on corporate leadership and was felicitated with memento by Sh. Shrikrishna Gupta, Raja Ramanna Fellow, DAE; Former Outstanding Scientist, BARC; Former OSD, DAE Branch Secretariat, New Delhi and Former Project Director, Global Centre for Nuclear Energy Partnership (GCNEP), Bahadurgarh.

After the above presentation, a visit to the electron accelerator facilities was organized for the attendees of the function for RF Linac (10 MeV, 3/5 kW) used for social & industrial applications and DC Accelerator used for environmental applications (wastewater treatment). The attendees appreciated the indigenous efforts after witnessing the demonstration of compact X band RF Linac development for cancer therapy at EBC. The program ended with an interaction, feedback session from the participants, followed by lunch and group photograph.



Group Photograph during INAE Mumbai Local Chapter Women's Day

- A Seminar was organized by INAE Delhi Chapter on 24th March 2023 on “Resilience of Structures and Infrastructure under Extreme Transient Loads” by Prof. Dr Adnan Ibrahimbegovic, Professor Classe Exceptionnelle, Member Senior IUF-Institut Universitaire of France and Chair for Computational Mechanics at University of Technology Compiegne, a member of Alliance of Sorbonne Universite (created with merger of Paris-Sorbonne and Universite Pierre Marie Curie). The Abstract and Speaker's bio of the lecture can be viewed by [clicking here...](#)
- Webinar was organized by INAE Chennai Chapter on 25th March 2023 on "Atmanirbhar Bharat through Reforms in Engineering Education" by Prof. B.S. Murty, Director, Indian Institute of Technology Hyderabad.

Reports received in this period pertaining to Local Chapter events held in previous months

INAE Webinar at NITIE Mumbai

As per the new initiatives of INAE Mumbai Local Chapter an informal meeting was arranged at NITIE, Mumbai on July 01, 2022 between the guest speaker Dr. Anuradha Narsimhan, Professor of Practice at IIT Bombay with students and faculty members from NITIE who delivered a talk on “Entrepreneurship: To Be or Not to Be”. After the talk, the discussions covered a wide range of topics related to academics and research work being pursued at NITIE on entrepreneurship and various concurrent issues and challenges. The students presented their research problems and suitable guidelines were provided by Dr. Anuradha Narsimhan.



Audience during the INAE Mumbai Local Chapter Lecture

In the webinar, entrepreneurship and its relevance in the present-day context was highlighted by the speaker. The basic guidelines for an entrepreneur and the fundamental concepts of entrepreneurship, opportunity identification, customer discovery, customer value proposition, marketing and Go-to-Market strategy were highlighted by the speaker. The talk provided a bird's eye overview to the students and aspiring entrepreneurs. With a strong background in industry and academia, the eminent expert Prof Anuradha Narsimhan touched upon concurrent topics with many real-life examples of aspiring entrepreneurs and start-ups from industry and academia. Several of these could achieve the status of unicorns with one billion dollar plus turnover very rapidly.

The program ended with a networking session in which a meeting was arranged between Director NITIE, NITIE faculty members, the Guest Speaker, Dr. Anuradha Narsimhan and INAE Mumbai Local Chapter co-chairs, Prof. Ram Kumar Singh and Prof SV Kulkarni and the Secretary, Prof. Archana Sharma. It was decided that IIT Bombay and NITIE may initiate collaboration focussing on topics of mutual interest that are also of relevance to the industry. It was also decided that apart from initiatives for motivating students and faculty members, the INAE Mumbai local chapter would make endeavours for more active participation of research institutes and industry.



Pictorial Glimpses of the INAE Mumbai Local Chapter Lecture



Pictorial Glimpses of the INAE Mumbai Local Chapter Lecture

INAE Webinar at Electron Beam Center, Kharghar on September 12, 2022



INAE Mumbai Chapter has organized a half day webinar on "Indigenous Electron Beam Accelerators for Agriculture and Industries" in association with BARC on September 12, 2022. It was held in hybrid mode (online and offline both) at Electron Beam Centre (EBC), Kharghar, Navi Mumbai, a BARC facility. Dr. Ram Kumar Singh, FNAE, Former Associate Director RDDG, BARC chaired the webinar and introduced the speaker. Mr. Shrikrishna Gupta, Raja Ramanna Fellow, DAE; Former Outstanding Scientist, BARC; Former OSD, DAE Branch Secretariat, New Delhi and Former Project Director, Global Centre for Nuclear Energy Partnership (GCNEP), Bahadurgarh, Haryana delivered a talk during the said webinar. Mr. Gupta explained in detailed about potential application of electron beam (EB) for improvement in switching performance of semiconductors, cross linking of polymers, sterilization of medical products etc. The application of EB to preserve food commodities, enhancing the shelf life of grains, pulses, onion, fruits etc, development of new varieties of crops by seed mutations and bio-stimulators for agriculture applications are highlighted. Followed by Mr. Gupta's presentation, a visit to electron accelerator facility was organized for attendees along with demonstration of different

agriculture products developed with EB at EBC, Kharghar. Many scientists from BARC, agriculture institutes, retired scientists, personnel from industries and students were attended the webinar. During his concluding remark Sh. P. C. Saroj, Project Manager EBC thanked all the participants.

INAE-SERB Conclave on *Atmanirbhar* Technologies: Engineering a Secure Future

INAE Kanpur Local Chapter, under the aegis of INAE and SERB, organized a two-day conclave on 5-6 November 2022 at IIT Kanpur on the following themes Clean energy and carbon capture; Medical technology, implantable devices, and non-invasive imaging and Semiconductor technology and the future of electronics. The conclave was well attended. A total of 83 participants from outside IITK joined the conclave. They included students and faculty members from colleges all over the country. All the talks and panel discussions were live-streamed on YouTube.

Day 1 - <https://youtu.be/PkupNo3v9X8>

Day 2 - <https://youtu.be/rWZZKtET-F4>

The conclave was inaugurated in the presence of Prof. Ashutosh Sharma, Chief Guest; Prof. Abhay Karandikar, Director, IIT Kanpur Prof. Yogesh M Joshi, President INAE Kanpur Chapter, IITK and Prof. Rahul Mangal, Secretary INAE Kanpur Chapter, IITK. It was followed by an illuminating talk by Prof. Ashutosh Sharma describing the path to self-reliance. A total of seven invited excellent talks, spread across the two days, oriented towards the conclave's theme, were made. The List of speakers and titles of their talks are given below:

- Prof. V. Ramgopal Rao, Department of Electrical Engineering, IIT Delhi on *Semiconductor Technology*
- Prof. Ashutosh Sharma, Department of Chemical Engineering, IIT Kanpur, on *Being Atmanirbhar from Invention to Innovation: Challenges, Opportunities and Processes of the Brave New World*
- Prof. Vishwanath Prasad, University of North Texas Discovery Park, TX, USA on *Clean Energy: Is there a choice*
- Prof. Milind Atre, Department of Mechanical Engineering, IIT Bombay, Mumbai on *Development of Multistage Pulse Tube Cryocoolers to cool the I-R detector*
- Prof. Pramod P Kulkarni, NSB-NTPC School of Business, Noida, UP on *Clean Energy and Carbon Capture*
- Prof. Neetu Singh, Center or Bio-Medical Engineering, IIT Delhi on *Medical Technology*
- Prof. Niraj Sinha, Mechanical Engineering, IIT Kanpur on *Medical technology, implantable devices, and non-invasive imaging*

All the talks were well attended, and there were interesting discussions with the speakers well into the break sessions. A panel discussion on *Driving India forward through frugal innovations* was moderated by Prof. Sameer Khandekar, IIT Kanpur with following panelists: Prof. Animangsu Ghatak, IIT Kanpur; Prof. Bishakh Bhattacharya, IIT Kanpur and Prof. Ramkumar, IIT Kanpur. The discussion sparked deep interactions and brainstorming. The discussion highlighted the frugal mindset in our culture, lateral thinking, and how they helped solve problems at a much lesser cost and the Mangalyaan project of ISRO was well cited.

To bring in student and start-up participation, three competitions were held on Innovative products – prototypes; Grand ideas challenge and Ideation of Start-ups. A total of 120 team entries were received. After shortlisting, 16 teams presented their work. All presentations were of high quality. The conclave ended with the prize distribution and valedictory session, graced by Prof. Amalendu Chandra, Dean of Faculty Affairs IITK and Prof. Indranil Manna, President INAE who joined through zoom and addressed the gathering.

Snapshots of the INAE-SERB Conclave on Atmanirbhar Technologies: Engineering a Secure Future





INAE-SERB Conclave on Atmanirbhar Technologies Engineering a Secure Future -Group Photograph

Interaction with Government Bodies.

The following meetings of Joint Consultative Committees were held during the quarter January to March 2023:

- (i) **CSIR-INAE Consultative Committee Meeting** was held on February 27, 2023 wherein a brief presentation was made on the activities of INAE. A few of the futuristic areas identified wherein INAE and CSIR can collaborate are as follows: Clean Hydrogen; Carbon Capture; Future of Communication; Future of Mobility; Promoting education in engineering and technology at higher level and to Enhance the skills of young engineers from industries. During the meeting, it was decided that INAE could contribute at a project level for technical consulting as well as monitoring, pointers for challenges etc. This could be initiated once the specific targets/areas are identified by CSIR and shared with INAE so as to identify domain experts at INAE. The way forward for joint collaborative activities was discussed.
- (ii) **SERB-INAE Consultative Committee Meeting** was held on March 6, 2023 which was attended by Secretary, SERB; President, INAE and Members of the Committee from INAE and SERB. A presentation was made by INAE on flagship events held each year. Progress on the joint programmes of INAE with SERB viz INAE-SERB Abdu Kalam Technology Innovation National Fellowship; INAE-SERB Collaborative Initiative in Engineering and INAE -SERB Digital Gaming Research Initiative was discussed. Discussions on the way forward for future collaborative activities as well as continuing of present joint initiatives were deliberated. It was suggested to develop an “Industry-Academia flagship program” to lead to the outcome of technology transfer/commercialization through project proposals with impactful results.

International Affairs

CAETS Engineering Education Working Group

As the only engineering Academy of the country, INAE represents India at the International Council of Academies of Engineering and Technological Sciences (CAETS); which is a premier non-governmental international organization comprising Member Academies from 31 countries across the world, with the objective of contributing to the advancement of science and technology and promoting sustainable economic growth of all nations. INAE also organizes workshops/events with CAETS Member Academies on topics of mutual engineering interest. The CAETS Council had requested President, INAE to Chair the CAETS Engineering Education Working Group (EEWG) for which consent has been given by INAE. A Meeting of CAETS Engineering Education Working Group was held on March 31, 2023 which was Chaired by President, INAE and attended by experts from INAE to discuss the questionnaire from CAETS and the way forward in bringing out a pertinent policy paper with actionable recommendations on promoting the growth of Engineering education across the world. The objectives of the Group are central to the CAETS policy on Engineering Education: (i) Promote ethics in engineering education, research, and practice and (ii) Contribute to continuous improvement and modernization of engineering education and practice internationally. Since engineering is all about translating fundamental knowledge into viable solutions to address human aspirations and societal challenges, engineering education must connect to the industrial practices and demands, application methodology, technological innovations awaited, and challenges related to raw materials, energy, environment, and efficiency. The overarching aim is to develop an engineering education policy that will promote economic growth and prosperity for the entire world with optimal use of resources and without inviting any penalty.

The Questionnaire covers the following points i) Vision and Mission and (ii) Policy or Committee or Mandate on Engineering Education of the Academy; Suggested topics for this EEWG (up to 5) that should relate to the overall goals of CAETS and objectives of the other Working Groups of CAETS; Suggestion on the functioning (meetings, information exchange, documentation, deliverables) and main objectives on this EEWG and Suggestion on the functioning (meetings, information exchange, documentation, deliverables) and main objectives on this EEWG. A short note was also requested on Engineering Education Curriculum in the concerned country (years of education to obtain a degree or diploma, name of the Regulatory Body, most popular and subscribed branches of engineering in that country, major strength, challenges, and priorities of the industry, etc.). These inputs would help understand the importance of engineering education and the scope of industry-academia synergy in the concerned country. INAE is Chairing this activity and shall play a major role in steering this activity to its logical conclusion through interaction with Member Academies of other countries and deliberations/consultations to be held online in arriving at the envisaged policy recommendations to further the cause and growth of engineering education in India and abroad.

CAETS Energy Report



The CAETS 2022 Energy Report on “Towards Low-GHG Emissions from Energy use in Selected Sectors” was released during the CAETS 2022 Annual Meetings and International Conference on “*Engineering a better world: Breakthrough Technologies for Healthcare*” hosted by the National Academy of Technologies of France (NATF) in Versailles, near Paris, France on September 27-28, 2022, in which INAE Delegation led by Prof Indranil Manna, President, INAE participated. Mr Pradeep Chaturvedi, FNAE had been nominated as INAE representative for CAETS Energy Committee and Mr Pradeep Chaturvedi and Dr. Bibek Bandyopadhyay, FNAE had been invited as INAE members for Working Group on Buildings for CAETS Energy Committee. Prof. SS Chakraborty, FNAE had also been nominated INAE Member for Working Group on Cement Industry for CAETS Energy Committee. Mr Pradeep Chaturvedi, FNAE; Prof Bibek Bandyopadhyay, FNAE and Prof SS Chakraborty, FNAE along with other INAE Fellows contributed to the preparation of the said report with representatives of other CAETS Member Academies and members of CAETS Energy Committee from other countries. Two special presentations to CAETS Energy Group. Were also held wherein Mr MS Unnikrishnan, FNAE made a presentation on Heat Pumps; and Dr Ambuj Sagar, IIT Delhi made a presentation on Policy Issues. These were appreciated, and some references were made. INAE had also provided previous energy reports that were referred to decide on the structure of the report, mainly for the industrial sectors on decarbonising. INAE Forum on Energy under the Chairmanship of Dr Ajay Mathur, FNAE met frequently to discuss the inputs from INAE for the report; especially the drafts of Executive Summary; Recommendations and the total Report; and also for identifying experts for special presentations. During the CAETS 2022 Annual Meeting at France the contributions of INAE Fellows in preparation of the said report was highly appreciated.

The CAETS Energy Report on “Towards Low-GHG Emissions from Energy Use in Selected Sectors” can be viewed by [clicking here....](#)

The Executive Summary of the Report can be viewed by [clicking here...](#)

A brief on the report is given below.

Introduction: The Energy Committee of the International Council of Academies of Engineering and Technological Sciences (CAETS) has been tasked with reviewing existing technologies which can be used immediately to reduce greenhouse gas (GHG) emissions in seven key sectors: Food and Agriculture, Buildings and Smart Cities, Oil and Gas, Chemicals, Cement, Iron and Steel, Information and Communication technologies. Some of our conclusions could apply as well to other sectors like aluminium. The deployment of these technologies would lead to deep emission reduction before 2040 which explains why the primary time frame of the report is 2020-2040. However, these technologies are not sufficient to meet net zero targets by mid-century. Therefore, the report also highlights research and development needs for new or improved technologies and demonstrations for the near ready technologies (RD&D). While many cost-effective GHG mitigating technologies exist, the GHG emissions are still growing in many countries and worldwide. Indeed, many obstacles remain. The purpose of this report is not to analyse all of them. Undeniably, social and economic issues are critical to the global implementation of the Paris COP21 Agreement and subsequent COP meetings. These issues include: the impacts of world population growth, improvements to the quality of life in developing countries and regions, choices made by political and industrial leaders, etc., and they are important aspects. However, they are not within the scope of this report which is technical, and it is meant to highlight technologies suitable for lowering GHG emissions, their advantages and limitations, and describe the technical, economic and cultural barriers that may exist. The Report offers insights; conclusions and recommendations that should be useful for leaders of industry, governments, professional organisations (especially engineering organisations), non-governmental organisations, and citizens. The report is intended to provide clarity on the complex issues of our subject: what is possible for the next 20 years, where are the difficulties in the different sectors and how to overcome them.

Who prepared this report and how?

The CAETS (International Council of Academies of Engineering and Technological Sciences) Member Academies have three main characteristics: (1) their members are drawn from most sectors of activity, mainly from industry and academia; (2) they are collectively independent and neutral, without *a priori* advocating for any technology or sector; (3) their reports are evidence-based and resulting from exchanges based on facts and on their diversity of experience. Indeed, CAETS, with its different Member Academies from various countries, reflects this diversity. They are allowing an international approach illustrated by the numerous case studies and examples reproduced in this report prepared by more than 60 fellows and some external experts of more than 20 countries. Given the time (15 months) and the resources available for the preparation of this report, we have looked for sectors with substantial emission levels and where the diversity of our active members could make the greatest contribution. In 2019, the seven sectors selected accounted for 73% of industry's CO₂ emissions (see Chapter 0, *Fig. 0.2.*) and around 60% of worldwide methane emissions. We did not select electricity generation as this topic was already largely covered by previous reports, neither the transport sector which could be an entire future study by its own. In this report, each of the above sectors is the subject of a dedicated chapter prepared by a subgroup of the Committee and discussed by the Committee. Each chapter was reviewed by external and internal reviewers. The chapters do not claim to be exhaustive but present the main elements, as seen by the participants, and are accompanied with examples taken from different countries. During our meetings, held remotely via teleconferencing, key messages and recommendations emerged from our often-lively discussions. They are not necessarily original or new but should, nevertheless, be most useful to implement.

INAE Publications

(i) **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 8 Issue 1, March 2023** was published through Springer Publishers during the quarter.

(ii) **Compendium on “Women Engineers in India Vol. I”**

The Government of India launched a 75-week celebration of India’s 75th year of Independence (*Azadi ka Amrit Mahotsav*) in March 2021 and Department of Science and Technology (DST), Government of India requested all Autonomous bodies under its aegis to conduct technical programmes and activities to mark the celebrations. It was thus envisaged in June 2021 to bring out a Compendium on “Women Engineers in India- Volume I” as no such document is available anywhere. This initiative of publishing a compendium on “Woman Engineers in India-Volume I” assumes added importance primarily as the ratio of eminent women professionals in engineering compared to their male counterparts is rather insignificant and secondly, because no authentic database or source is available in the country that documents the contributions of woman professionals and scholars in engineering and technology in the leadership role. Gender parity is absolutely essential for our country not only to accelerate economic growth and societal balance, but also to harness the demographic dividend of the large and very young population of India.

To realize this noble ambition, a detailed exercise was undertaken wherein Heads of Academic institutions, R&D Organization and Industrial Houses were requested to nominate deserving women engineers for inclusion in this Compendium. An Editorial Committee was constituted under the Chairmanship of Prof Purnendu Ghosh, Vice-President, INAE to undertake the task.

Periodic meetings of the Editorial Committee were held with active and sustained contributions of all Members. A Master List of nominees based on suggested names of women engineers was prepared with inputs received from the Members of the Editorial Committee and Heads of Academic Institutions, R&D organizations and Industry in response to letters from President, INAE and the nominees for this volume were chosen by adopting laid down yardsticks and criteria. The nominations received were scrutinized by the Editorial Committee based on a set of guidelines laid out for selection of the worthiest nominees through wide and multi-tier consultation for inclusion of their contributions in the compendium.

The contributions of seventy-five nominees finally shortlisted are contained in this compendium which it is hoped shall meet the objectives of felicitating the eminent women engineers as well as inspiring bright women talents in the country to take up engineering as their future professional goal. The selection in this compendium is neither beyond question nor the final. This exercise was not intended only to choose the champions, but to highlight the most eminent women engineers who championed engineering in different era despite all odds and hence could serve as the role models worth emulating by the future generations. This volume is seen as a sincere endeavour to showcase a selected few women-engineers who made seminal contributions in engineering and technology that were as eminent and important as that made by the male counterparts of their time.



Release of Compendium on “Women Engineers in India- Volume I” during National Science Day Celebrations 2023

Messages from Dr Jitendra Singh, Hon’ble Minister of State (Independent Charge) for Science and Technology and Earth Sciences and Dr. Srivari Chandrasekhar, Secretary, Department of Science and Technology (DST), Govt. of India are featured in the Compendium on “Women Engineers in India Vol. I”. INAE firmly believes that publishing a comprehensive and attractive compilation of the most illustrious women engineers of the country will surely encourage many young girls to choose engineering as a career option and dedicate themselves in making engineering a viable tool to boost the country’s record in innovation and standing as a global technological superpower in due course.

Hard copies of the Compendium “Women Engineers in India- Volume I” have been presented to the Editorial Committee; women engineers featured in the Compendium and several Government officials such as Shri Thaawarchand Gehlot, Hon’ble Governor of Karnataka; Smt Smriti Irani, Hon’ble Union Cabinet Minister for Women & Child Development and Minority Affairs; Dr Sanjeev Sanyal, Principal Economic Advisor to the Government of India; Shri Rajiv Gauba, Cabinet Secretary; Prof AK Sood, PSA to Govt. of India; Prof TG Sitharam, Chairman, AICTE; DST Officials; Prof. M. Jagadesh Kumar, FNAE, Chairman, UGC; Dr G Satheesh Reddy, FNAE, Scientific Advisor to Rakhsha Mantri, Govt. of India; Secretaries of Strategic Departments viz Dr KN Vyas, FNAE, Secretary, DAE and Chairman, Atomic Energy Commission; Dr SV Kamat, FNAE, Secretary, Department of Defence R&D an

Chairman, DRDO and Mr S Somanath, FNAE, Secretary, DoS and Chairman, ISRO and other officials. A Message from the Hon'ble Governor of Karnataka can be viewed by [clicking here ...](#)



Dr Tessy Thomas, FNAE and Ms Nazneen Banu, presenting a copy of the Compendium on “Women Engineers in India- Volume I” to Governor of Karnataka- Shri Thaawarchand Gehlot



Prof Indranil Manna, President, INAE presenting copy of Compendium on “Women Engineers in India Vol I” to Smt Smriti Irani, Hon'ble Union Cabinet Minister for Women & Child Development and Minority Affairs

(iii) Compendium on “Landmark Achievements in Engineering and Technology in Independent India”

The Compendium on “Landmark Achievements in Engineering and Technology in Independent India” was also compiled by the INAE as a part of the 75-week celebration of India's 75th Year of Independence (*Azadi ka Amrit Mahotsav*) to showcase the country's seminal achievements in this domain. In order to diligently pursue the onerous task of documenting the most significant engineering and technological achievements of the country in the last 75 years, a Task Force was constituted under the chairmanship of Prof. Prem Krishna, a former Vice President of INAE to steer this project with representative experts from each of the ten Engineering Sections of the Academy. The Task Force solicited inputs from the entire Fellowship and resources available throughout the country. Suggestions and nominations for entry into the compendium were thus invited from the major industries, strategic Departments, national institutions, R&D Organizations besides Fellowship of INAE, INAE Young Associates, students, professionals and top organizations. The topics were chosen based on well-defined criteria and after due

deliberations by the Task Force Members. A Master list of over 750 items was created after several revisions before the final selection of the 75 entries distributed into eight groups were identified by the Members of the Task Force based on the five criteria, namely, benefit to the society/country/industry sector, significance of the engineering feat, impact of contribution with respect to number of people benefitted, uniqueness and novelty, and technological leadership. Engineering is meant to designing and providing solutions to societal aspiration and hence the usefulness of the contribution to the masses was given due importance in selection of the landmark achievements. The initial list allocated of over 750 items were allocated into 16 sector areas was reduced to the desired number of 75, divided into 8 groups. The eight groups are Energy, Infrastructure, Communication, Digital, Systems, Chemicals & Materials, Food & Healthcare and Aerospace. While it is to be expected that all the items included in this volume constitute landmark achievements, it is reasonable to state that there are many which could not cross the line and get included, because the number was limited. The articles pertaining to the eight sectors are preceded by a brief on INAE and an article on engineering education. Members of the Task Force representing the corresponding Engineering Sections, along with 3-5 champions co-opted by each, were requested to prepare the write-ups, guided by a given format.

It is noted that the engineering solutions are seldom unique, especially considering the geography, resources, timeframe, economic and political backdrop. Hence, the selection of 75 landmark achievements in this compendium can neither be unique nor beyond question. Suffice to say that the intention here was not to examine the superiority but to emphasize the importance and impact of such engineering feats that certainly made a huge difference to the quality of life and technological progress of the nation. In other words, the endeavour was aimed more to showcase such engineering success that would inspire many more and even bigger success in engineering and technology in the future. The compendium was realized because of the contributions from Fellows and Heads and Members of Corporate Bodies, Strategic Sectors, Academia, and R&D organizations. Messages from Dr Jitendra Singh, Hon'ble Minister of State (Independent Charge) for Science and Technology and Earth Sciences and Dr. Srivari Chandrasekhar, Secretary, Department of Science and Technology (DST), Govt. of India are featured in the Compendium on "Landmark Achievements in Engineering and Technology in Independent India".



Release of Compendium on "Landmark Achievements in Engineering and Technology in Independent India" during National Science Day Celebrations 2023

Hard copies of the Compendium have been presented to the Task Force Members; Dr Sanjeev Sanyal, Principal Economic Advisor to the Government of India; Shri Rajiv Gauba, Cabinet Secretary; Prof TG Sitharam, Chairman, AICTE; DST Officials; Prof. M. Jagadesh Kumar, FNAE, Chairman, UGC; Dr G Satheesh Reddy, FNAE, Scientific Advisor to Rakhsha Mantri, Govt. of India; Secretaries of Strategic Departments viz Dr KN Vyas, FNAE, Secretary, DAE and Chairman, Atomic Energy Commission; Dr SV Kamat, FNAE, Secretary, Department of Defence R&D and Chairman, DRDO and Mr S Somanath, FNAE, Secretary, DoS and Chairman, ISRO and other officials. Prof M Jagadesh Kumar tweeted “*INAE brought a Compendium on “Women Engineers in India Vol. I” and another on “Landmark Achievements in Engineering and Technology in Independent India.” He presented a copy of both books’ worth reading by the University community. Look forward to working with INAE.*”



Prof Indranil Manna, President, INAE presenting copies of Both Compendiums to Prof M Jagadesh Kumar, Chairman, UGC

(iv) INAE Report of Committee on “Technological Preparedness for Dealing with National Disruptions”

An important initiative undertaken by the Academy under the aegis of the Azadi ka Amrit Mahotsav celebrations in bringing out a Report of Committee on “Technological Preparedness for Dealing with National Disruptions”. India is prone to many natural and man-made disasters and INAE taking note of unprecedented Covid pandemic, felt that there is a need to enhance the technological preparedness of the nation to face these national disruptions/disasters of different types and formulate engineering interventions to cope with to such calamities. Therefore, a number of committees with domain specialists with the primary aim to examine technology preparedness of the country to face such exigency was undertaken, overseen by a Peer Committee chaired by Dr PS Goel, former President, INAE and Formerly Secretary, Ministry of Earth Sciences and Chairman, Earth Commission and Director, ISRO Satellite Centre, Bangalore.

The following six domain were identified, and expert committees were constituted viz. Weather and climate related disasters; Ocean related disasters; Geological related disasters; Health related disasters; Cyber security related disasters and Fire related disasters. Each expert committee had several meetings within themselves and across the expert committees as some of them have overlapping activity. Peer committee had several interactions with each expert committee primarily to steer the studies towards what kind of engineering preparedness the country needs to create in terms of basic science, tools & gadgets, instruments, equipment, communication & connectivity etc. The expert committees were also advised to address policy issues and any new mechanism or bodies that need to be set up in the country.

This report is an outcome of this exercise. The recommendations outlined in each expert committee report have focused on implementable aspect and create additional mechanisms, where needed. There is no claim that these will solve all problems related to disasters, but certainly, if accepted and implemented, the country will be better prepared to face the national disasters in the future. This report is organized in two parts. Part I gives the consolidated recommendations emerging from the 6 expert committees and the discussions in the Peer committee, organized as per the agencies responsible for the engineering preparedness, namely the agencies and departments of the GoI. Some of the recommendations have been repeated against more than one agency. It is because one agency may be user while other may be provider. It is recognized that NDMA is the prime body responsible for providing immediate relief on the ground, however we need additional mechanism(s) to organize the engineering preparedness and practically all S&T agencies are involved in this activity. Part II of the report gives the study and recommendations of the 6 expert committees. These studies are the basis of this report but should not be seen in isolation. A lot of interaction has taken place, where necessary, within the expert committees and the peer committee. Finally, the overall recommendations have attempted to provide an integrated approach to the engineering preparedness for Disaster Management. The *report* of Committee on “Technological Preparedness for Dealing with National Disruptions” details the exercise of understanding the sources and nature of such disasters, identifying the gaps and recommending the engineering/technological solutions to be implemented by various agencies. It is our belief that once these recommendations are implemented, the country would be better prepared to face these disasters, natural or manmade, in dealing with and reducing loss of life and property.



Release of INAE Report of Committee on “Technological Preparedness for Dealing with National Disruptions” during National Science Day Celebrations 2023

INAE Compendiums on "Women Engineers in India Vol 1" prepared by the Editorial Committee under the Chairmanship of Prof Purnendu Ghosh, former Vice-President, INAE and "Landmark Achievements in Engineering and Technology in Independent India" prepared by the Task Force under the Chairmanship of Prof Prem Krishna, former Vice-President, INAE; both prepared under the aegis of the Azadi ka Amrit Mahotsav celebrations of the Government of India and published by Vigyan Prasar were released by the Chief Guest, Dr Jitendra Singh, Hon'ble Minister of State (Independent Charge) for the Ministry of Science and Technology & Earth Sciences during the National Science Day Function 2023 organized by DST, Govt. of India at Vigyan Bhawan on February 28, 2023 in presence of the PSA to Govt. of India Prof. Ajay Kumar Sood; Prof K VijayRaghavan, former PSA to Govt. of India; Dr S Chandrasekhar, Secretary, DST and other dignitaries. The INAE Report on of Committee on “Technological Preparedness for Dealing with National Disruptions” prepared under the Chairmanship of Dr PS Goel, former President, INAE was also released by the Hon'ble Minister during the Function.

The YouTube link for viewing the function is <https://www.youtube.com/watch?v=Z-FFeq4dP2o>

Donations to INAE Corpus Fund

Prof Indranil Manna, President, INAE vide letter dated March 29, 2023 addressed to the Fellowship recalled that the Department of Science and Technology (DST), as directed by the Department of Expenditure, Government of India (GoI) is in the process of disengaging itself from the activities of INAE including providing the annual financial support w.e.f. 31st March 2025. To address the issue of sustainability of INAE, we had several meetings with high level Government officials, former Presidents and senior Fellows of INAE, and industry leaders in the last 10 months since the formal letter from DST (dated 6.5.22) was served to INAE about disengagement. While efforts would continue to impress upon the Government that INAE is essential to realize the country's agenda on engineering and technology, it is now amply clear that INAE must undertake a serious effort to generate an adequate Corpus Fund and attain financial self-sufficiency.

He further brought out that Engineering is all about evolving viable solution to prevailing or future challenges and aspirations. Hence, the present crisis may be viewed as an opportunity for INAE to emerge stronger and more resolute to fulfil its core objective of serving the profession and the nation in a more comprehensive manner. He hoped that each Fellow would agree that the onus of confronting the current crisis and eventually winning over can rest neither on a few office bearers nor only on a nominated committee. If INAE has to tide over this unprecedented and most unfortunate crisis, every single Fellow, Associate, Awardee and mentor of INAE must come forward and make a useful and decisive contribution. In this direction, he apprised that after sustained efforts, INAE has been given the approval by the Competent Authority for the creation of a new corpus fund from INAE's own resources (internal accruals) in accordance with the Rule 229 (iv) & (v) of General Financial Rules (GFR), 2017 of the GoI on 24th March 2023. Contributions have since been received for INAE Corpus Fund from INAE Fellowship and the process is ongoing. The details for forwarding of donations and tax benefits to donors are given below:

Bank Details for receipt of donation to INAE:

Name of beneficiary: **INAE Corpus Fund**

Account Number: **41790835603**

Bank Address: **Jawaharlal Nehru University, New Mehrauli Road, New Delhi**

Type of Account: **Savings**

IFSC: **SBIN0001624**

Tax benefits for donors

The contribution to the **INAE Corpus Fund** qualifies to be considered under the category of donation and is eligible for 50% tax deduction under section 80G. The donors will get a receipt and the 80G certificate within a fortnight.

INAE is extremely grateful to all Fellows who have generously contributed to the INAE Corpus Fund and welcomes further contributions/donations from Fellows, Young Associates, Awardees; Industry Leaders and Industry Houses etc with a view to achieving self-sufficiency in functioning in the near future.

Important Meetings held during January, February and March 2023

List of Meetings in January 2023

- Jan 18 42nd Apex Committee Meeting on 18th Jan 2023 (Wednesday) at 5 PM
- Jan 27 CMP Services Management INAE
- Jan 28 Character in Globalization: Retaining dignity and individuality in a not so flat world of free-market and globalization.
- Jan 31 Chemical Parks in India: Sparking a Game changer

List of Meetings in February 2023

- Feb 7 Meeting of INAE Local Chapters Chairpersons/Office Bearers with President, INAE on 7th February from 5 PM to 6:30 PM
- Feb 9 Meeting on future of INAE
- Feb 16 Meeting of CAETS Engineering Education Working Group
- Feb 21 43rd Apex Committee Meeting on 21st February 2023 (Tuesday) from 4 PM to 5:30 PM
- Feb 27 CSIR-INAE Consultative Committee Meeting

List of Meetings in March 2023

- Mar 6 SERB-INAE Consultative Committee Meeting.
- Mar 11 Women contributions in engineering and technology
- Mar 21 37th Finance Committee meeting on 21st March 2023 (Tuesday) from 3 PM to 4 PM
- Mar 24 Meeting of the INAE Forum on Civil Infrastructure (HOUSING)
- Mar 25 Preliminary meeting from 9:30 AM to 10 AM on 25th March 2023 (Saturday) prior to Advisory Committee meeting
- Mar 25 INAE Corpus Fund - Meeting of the Advisory Committee at 10:30 AM on 25th March 2023 (Saturday) over WebEx
- Mar 25 *Atmanirbhar Bharat* through Reforms in Engineering Education
- Mar 25 INAE Corpus Fund - Meeting of the Steering Committee from 4 PM to 5 PM on 25th March 2023 (Saturday) over WebEx
- Mar 27 Proposed online meeting of Conveners of all Sectional Committees with President, INAE from 10 AM to 10:45 AM on 27th March 2023
- Mar 27 146th Governing Council meeting on 27th March 2023 (Monday) from 11 AM to 3 PM in hybrid mode at IIC, New Delhi
- Mar 31 Meeting of CAETS Engineering Education Working Group

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

International Conference on Computational Science and Sustainable Technologies being held online and in-person on 8th to 9th May 2023 at Bangalore, Karnataka

<https://conferencealerts.com/show-event?id=251259>

International Conference on Data Analytics and Insights Conference being held in-person on 11th to 13th May 2023 at Kolkata, West Bengal

<https://conferencealerts.com/show-event?id=251336>

International Conference on Recent Advances in Mechanical Engineering and Nanomaterials Conference being held online and in-person on 12th to 14th May 2023 at Bhilai, Chhattisgarh

<https://conferencealerts.com/show-event?id=251660>

i-SMaRT 2023 International Conference on Sustainable materials, Manufacturing and Renewable Technologies Conference being held online and in-person on 24th to 26th May 2023 at Cochin, Kerala

<https://conferencealerts.com/show-event?id=249232>

National Conference on "Sustainable Development of Smart Cities Infrastructures" 2023 (SDSCI-2023) Conference being held in-person on 27th to 28th May 2023 at Kurukshetra, Haryana

<https://conferencealerts.com/show-event?id=252765>

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HONOURS AND AWARDS

1	<p>Mr VN Heggade, FNAE, Former Executive Director of Gammon; Former CEO of STUP; and Founder DECon Complete Solutions has been selected as fib Fellow by the International Federation for Structural Concrete (fib). This distinction is given in recognition of his significant personal contributions to the work of the fib. The fib Fellow recognition will be presented during the opening ceremony of the 2023 Symposium in Istanbul on 5 June 2023. Mr VN Heggade also received that SB Joshi memorial award for excellence in Bridge & Structural Engineering instituted by COEP.</p>
2	<p>Prof AB Pandit, FNAE, Vice-President, INAE and Vice-Chancellor, ICT, Mumbai has been elected as a Member of National Academy of Engineering, USA in recognition of his outstanding contributions to cavitation reactors from concept to commercialization, and engineering solutions to improve the lives of underserved people.</p>
3	<p>Prof RI Sujith, FNAE, D. Srinivasan Institute Chair Professor, Department of Aerospace Engineering, IIT Madras has been elected as a Member of National Academy of Engineering, USA in recognition of his outstanding contributions in terms of applications of dynamical systems theory to the understanding and control of instabilities in engineering systems.</p>
4	<p>Dr. Ulrich L. Rohde, FNAE, Chairman, Synergy Microwave, NJ USA; Partner, Rohde & Schwarz, Munich, German Chair Office of the President, Dept. of R & D, Jt. Forces (DOD) Univ. of Munich, Germany, Professor, Brandenburg Univ. of Tech. (BTU), Cottbus, Germany was conferred the 2023 IEEE Communications Society Distinguished Industry Leader Award by the IEEE Communications Society.</p>
5	<p>Prof Gautam Biswas, FNAE, Professor and J C Bose National Fellow, IIT Kanpur and Formerly Director, CSIR-Central Mechanical Engineering Research Institute (CMERI), Durgapur; Formerly Director, Indian Institute of Technology Guwahati has been selected to receive the 2023 ASME Heat Transfer Memorial Award in the science category “for sustained and outstanding scholarly contributions to thermal science and engineering, including heat transfer enhancement, phase change heat transfer with and without electrohydrodynamic forces, and dynamics of liquid jet and droplet impingement” by the American Society of Mechanical Engineers (ASME). Formal presentation of the award will take place during the 2023 ASME International Mechanical Engineering Congress and exposition being held on October 29- November 3, 2023 in New Orleans, USA.</p>

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NEWS OF FELLOWS

1,	<p>Prof M Packirisamy, FNAE, Professor & Concordia Research Chair, Director Micro Nano Bio Integration Centre, Concordia University, Canada has done breakthrough research on using sound waves for 3D printing of parts. It is the first time in world that it has been done. It was published in Nature Communications and covered throughout the world. It was selected as the Top10 Discoveries of Canada in 2022. Some links giving news on the research are given below.</p> <p>Direct Sound Printing in CBC with video: https://www.cbc.ca/news/canada/montreal/3d-printing-sound-waves-concordia-1.6718402</p> <p>CBC Radio Day Break Program; https://www.cbc.ca/listen/live-radio/1-15-daybreak-montreal/clip/15960717-concordia-researchers-honoured-work-printing-3d-objects-using</p>
2.	<p>Dr. Sirshendu De, FNAE, Professor, Department of Chemical Engineering, IIT Kharagpur created an invention regarding arsenic removal technology which is placed in Top 100 Indian Innovations (2022). The book is available for online sale.</p>
3.	<p>Prof. Amitava Datta, FNAE has been appointed as the Pro Vice-Chancellor of Jadavpur University, Kolkata.</p>
4.	<p>An authentic biography of 80-year journey of Dr. R.A. Mashelkar, FNAE, National Research Professor and Former Secretary, DSIR, Director General, CSIR, New Delhi; Former Chancellor, Academy of Scientific and Innovative Research (AcSIR) written by Dr. Sagar Deshpande was launched on 28th January 2023 at Pune.</p>
5.	<p>Dr Sanak Mishra, FNAE, Immediate Past-President, INAE and Member of the Governing Board of the Steel Research & Technology Mission of India. Formerly Managing Director, Rourkela Steel Plant and Director, Steel Authority of India Ltd. (SAIL); Vice-President, ArcelorMittal and CEO India Projects; Secretary General, Indian Steel Association delivered a talk as Special Guest of the International Conference on “Reducing Carbon Footprint in Metal Industries” organized by The Indian Institute of Metals, Rourkela Chapter, in association with SAIL-RSP and NIT Rourkela, on February 03-04, 2023 at Rourkela. Dr Sanak Mishra also delivered the Fifth Dr. Baldev Raj Memorial Lecture on "Evolution of Steel Technology and Current Indian Steel Scenario held in hybrid mode on 10th April 2023 at PSG College of Technology, Coimbatore.</p>
6.	<p>Prof SN Mukhopadhyay, FNAE, Adjunct Professor, Department of Biological Sciences, BITS, Pilani and Former Professor, DBEB, IIT Delhi; Former Professor & Head, BERCI, IIT Delhi; Former Professor SOBT, GBU, Greater Noida received invitation to be an invited speaker in GMTOXI2023 conference to be held in Lisbon, Portugal on Sept.25-27,2023.</p>
7,	<p>Prof DN Singh, FNAE, D.L. Shah Chair Professor for Innovation, Department of Civil Engineering, Indian Institute of Technology Bombay, Mumbai conducted an International workshop on Carbon Capture, Utilization, and Storage (CCUS).</p> <p>The YouTube videos are available at:</p> <p>Introductory Session https://youtu.be/udXwOTo7MZo</p> <p>Indian Industry & Concluding Session https://youtu.be/pa0TJ_zZR-A</p> <p>Foreign Partners https://youtu.be/NZvVm2ZyUFw</p>

8.	Dr. Naresh Chandra Murmu, FNAE, Chief Scientist & Head, Surf. Engg. & Tribology, CSIR-CMERI, Head, Business Innovation and Skills Division, CSIR-CMERI and Professor & Dean, Faculty of Engineering Sciences, Academy of Scientific and Innovative Research (AcSIR) was appointed as Director, CSIR-CMERI.
9.	Dr. U. Kamachi Mudali, FNAE, Vice Chancellor, Vellore Institute of Technology (VIT), Bhopal has recently taken over as Vice Chancellor, Homi Bhabha National Institute (HBNI), Mumbai.
10.	Dr Ajit Kumar Mohanty, FNAE, Director, BARC, Mumbai took over the charge of Chairman, Atomic Energy Commission, and Secretary to the Government of India, Department of Atomic Energy from Shri KN Vyas, FNAE in a ceremony held at the DAE Secretariat in Mumbai on Wednesday, May 3, 2023. Further details can be viewed at the link given below: https://dae.gov.in/node/10001

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INAE ON FACEBOOK AND TWITTER

INAE has created a Facebook and Twitter Account to post the news of recent INAE activities in the Social Media. The same can be viewed at the link below.

(a) Facebook -link <https://www.facebook.com/inaehq1>

(b) Twitter handle link <https://twitter.com/inaehq1>

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Obituary

Dr SJ Chopra



(April 29, 1941 – November 23, 2022)

Dr SJ Chopra, FNAE born on April 29, 1941 passed away on November 23, 2022. He was elected to INAE Fellowship in the year 2006 and affiliated to ES - IV (Chemical Engineering). Dr SJ Chopra, Founding Chancellor, University of Petroleum & Energy Studies (UPES), Dehradun had also served as Visiting Professor at IIT Delhi and IIT Roorkee. He was an institution builder and had made outstanding research contributions in Chemical Engineering particularly in Oil & Gas sector. Earlier he served as Director (Technical), Engineers India Limited and was also Chairman & Managing Director for a short duration. At UPES, he laid a futuristic pathway for education and played a nurturing role for the progress of the Institution which envisions itself as an institution of global standing, which fosters development of professionally-competent talent and contributes to nation-building.

May God Bless His Soul to Rest in Peace

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ENGINEERING AND TECHNOLOGY UPDATES

Civil Engineering

1. Energy-Efficient Construction Materials Work Better In Colder Climates, Say Researchers

Researchers from Lithuania and Cyprus claim that the energy payback period of using phase change materials, new technology in the construction industry, is the shortest in a colder climate. The optimal location for their usage is the interior on the northern side of the building. The study provides informed answers regarding the application of PCMs to improve buildings' energy efficiency. In recent years, phase change materials (PCMs) used to improve the energy efficiency of buildings are gaining momentum. PCMs can store and release large amounts of energy -- when in a solid phase, they can absorb heat, providing a cooling effect and when a PCM is in its liquid phase it can release heat, providing a warming effect. Together with colleagues from Frederick University in Cyprus, KTU researchers conducted a study in different European regions aiming to calculate the efficiency of the application of PCMs for the energy upgrade of the existing buildings. Their research revealed that the efficiency and energy payback period of PCM depends on certain conditions, such as the geographical location and the wall orientation of the building. The work examines the application of PCM coatings in diverse meteorological conditions in Europe, for all major buildings' orientations. In total, 16 numerical simulations were carried out for the four calendar months of January, April, July and October and for three latitudes of Athens, Milan and Copenhagen. The first 8 numerical simulations were performed with phase change material integrated into the building element structure and the other 8 simulations -- in the absence of PCM. The PCM thickness incorporated was 4 cm. The annual energy saving was calculated for four typical months, representing the four seasons of the year (winter, spring, summer, and autumn). "One of the main study outcomes highlighted the fact that PCM performed better under cold conditions," says researcher Klumbytė. According to the researchers, this makes perfect sense -- firstly, in colder conditions, PCM absorbs more energy, and secondly, since in colder climates the buildings use more energy (electricity, heating, etc.) the energy saving in these conditions is more efficient. "In the study, we have developed the energy payback period concept, which means the balance between the energy used to produce these materials and gained while using them. Energy payback period indicates how long it will take for the energy that is saved in the PCMs to eliminate the energy costs of their production," explains another researcher Fokaides. The study revealed that PCM implementation can contribute to energy savings in certain cases, varying from 0.24 up to 29,84 kWh/m²a and energy payback periods from less than a year to almost 20 years. The longest energy payback period was calculated in warmer climates, and the shortest -- in colder locations. The optimal orientation for placing PCMs is west and east in Athens, east and north in Milan, and north in Copenhagen. Also, PCMs work best when they are integrated into interior structures. According to Fokaides, the above-described study is researching topics that have not been discussed in scientific literature before. The optimal location of the phase change material in the building, its optimal orientation and the energy payback period are entirely new concepts in the broad theme of the energy performance of the built environment. The KTU researchers claim that the methodology and dataset provided in this work can be used for further development of the buildings' thermal assessment tools. Currently, the team is starting a new 1.5 million worth research project, which will focus on the digitalisation of the findings. This could include developing smart sensors to measure building elements' thermal performance in real-time and other aspects. According to scientists, this topic has vast potential for commercialisation.

Source <https://www.sciencedaily.com/releases/2023/02/230203105332.htm>

Computer Engineering and Information Technology

2. Autonomous Driving: New Algorithm Distributes Risk Fairly

Researchers at the Technical University of Munich (TUM) have developed autonomous driving software which distributes risk on the street in a fair manner. The algorithm contained in the software is considered to be the first to incorporate the 20 ethics recommendations of the EU Commission expert group, thus making significantly more differentiated decisions than previous algorithms. Operation of automated vehicles is to be made significantly safer by assessing the varying degrees of risk to pedestrians and motorists. The code is available to the general public as Open Source software. Technical realization is not the only obstacle to be mastered before autonomously driving vehicles can be allowed on the street on a large scale. Ethical questions play an important role in the development of the corresponding algorithms: Software has to be able to handle unforeseeable situations and make the necessary decisions in case of an impending accident. Researchers at TUM have now developed the first ethical algorithm to fairly distribute the levels of risk rather than operating on an either/or principle. Approximately 2,000 scenarios involving critical situations were tested, distributed across various types of streets and regions such as Europe, the USA and China. The research work is the joint result of a partnership between the TUM Chair of Automotive Technology and the Chair of Business Ethics at the TUM Institute for Ethics in Artificial Intelligence (IEAI). Maximilian Geisslinger, a scientist at the TUM Chair of Automotive Technology, explains the approach: "Until now, autonomous vehicles were always faced with an either/or choice when encountering an ethical decision. But street traffic can't necessarily be divided into clear-cut, black and white situations; much more, the countless gray shades in between have to be considered as well. Our algorithm weighs various risks and makes an ethical choice from among thousands of possible behaviours -- and does so in a matter of only a fraction of a second." The basic ethical parameters on which the software's risk evaluation is oriented were defined by an expert panel as a written recommendation on behalf of the EU Commission in 2020. The recommendation includes basic principles such as priority for the worst-off and the fair distribution of risk among all road users. In order to translate these rules into mathematical calculations, the research team classified vehicles and persons moving in street traffic based on the risk they present to others and on the respective willingness to take risks. A truck for example can cause serious damage to other traffic participants, while in many scenarios the truck itself will only experience minor damage. The opposite is the case for a bicycle. In the next step the algorithm was told not to exceed a maximum acceptable risk in the various respective street situations. In addition, the research team added variables to the calculation which account for responsibility on the part of the traffic participants, for example the responsibility to obey traffic regulations. Previous approaches treated critical situations on the street with only a small number of possible manoeuvres; in unclear cases the vehicle simply stopped. The risk assessment now integrated in the researchers' code results in more possible degrees of freedom with less risk for all. An example will illustrate the approach: An autonomous vehicle wants to overtake a bicycle, while a truck is approaching in the oncoming lane. All the existing data on the surroundings and the individual participants are now utilized. Can the bicycle be overtaken without driving in the oncoming traffic lane and at the same time maintaining a safe distance to the bicycle? What is the risk posed to each respective vehicle, and what risk do these vehicles constitute to the autonomous vehicle itself? In unclear cases the autonomous vehicle with the new software always waits until the risk to all participants is acceptable. Aggressive manoeuvres are avoided, while at the same time the autonomous vehicle doesn't simply freeze up and abruptly jam on the brakes. Yes and No are irrelevant, replaced by an evaluation containing a large number of options. The researchers emphasized the fact that even algorithms that are based on risk ethics -- although they can make decisions based on the underlying ethical principles in every possible traffic situation -- they still cannot guarantee accident-free street traffic. In the future it will additionally be necessary to consider further differentiations such as cultural differences in ethical decision-making. Until now the algorithm developed at TUM has been validated in simulations. In the future the software will be tested on the street using the research vehicle EDGAR.

Mechanical Engineering

3. Compact, Non-Mechanical 3D Lidar System Could Make Autonomous Driving Safer

Our roads might one day be safer thanks to a completely new type of system that overcomes some of lidar's limitations. Lidar, which uses pulsed lasers to map objects and scenes, helps autonomous robots, vehicles and drones to navigate their environment. The new system represents the first time that the capabilities of conventional beam-scanning lidar systems have been combined with those of a newer 3D approach known as flash lidar. Investigators led by Susumu Noda from Kyoto University in Japan describe their new nonmechanical 3D lidar system, which fits in the palm of the hand. They also show that it can be used to measure the distance of poorly reflective objects and automatically track the motion of these objects. "With our lidar system, robots and vehicles will be able to reliably and safely navigate dynamic environments without losing sight of poorly reflective objects such as black metallic cars," said Noda. "Incorporating this technology into cars, for example, would make autonomous driving safer." The new system is possible thanks to a unique light source the researchers developed called a dually modulated photonic-crystal laser (DM-PCSEL). Because this light source is chip-based it could eventually enable the development of an on-chip all-solid-state 3D lidar system. "The DM-PCSEL integrates non-mechanical, electronically controlled beam scanning with flash illumination used in flash lidar to acquire a full 3D image with a single flash of light," said Noda. "This unique source allows us to achieve both flash and scanning illumination without any moving parts or bulky external optical elements, such as lenses and diffractive optical elements." Lidar systems map objects within view by illuminating those objects with laser beams and then calculating the distance of those objects by measuring the beams' time of flight (ToF) -- the time it takes for the light to travel to objects, be reflected and then return to the system. Most lidar systems in use and under development rely on moving parts such as motors to scan the laser beam, making these systems bulky, expensive and unreliable. One non-mechanical approach, known as flash lidar, simultaneously illuminates and evaluates the distances of all objects in the field of view with a single broad, diffuse beam of light. However, flash lidar systems can't be used to measure the distances of poorly reflective objects like black metallic cars due to the very small amount of light reflected from these objects. These systems also tend to be large because of the external lenses and optical elements needed to create the flash beam. To address these critical limitations, the researchers developed the DM-PCSEL light source. It has both a flash source that can illuminate a wide 30°×30° field of view and a beam-scanning source that provides spot illumination with 100 narrow laser beams. They incorporated the DM-PCSEL into a 3D lidar system, which allowed them to measure the distances of many objects simultaneously using wide flash illumination while also selectively illuminating poorly reflective objects with a more concentrated beam of light. The researchers also installed a ToF camera to perform distance measurements and developed software that enables automatic tracking of the motion of poorly reflective objects using beam-scanning illumination. The researchers demonstrated the new lidar system by using it to measure the distances of poorly reflective objects placed on a table in a lab. They also showed that the system can automatically recognize poorly reflective objects and track their movement using selective illumination. The researchers are now working to demonstrate the system in practical applications, such as the autonomous movement of robots and vehicles. They also want to see if replacing the ToF camera with a more optically sensitive single-photon avalanche photodiode array would allow the measurement of objects across even longer distances.

Chemical Engineering

4. Fighting Climate Change: Ruthenium Complexes for Carbon Dioxide Reduction to Valuable Chemicals

Climate change is a global environmental concern. A major contribution to climate change comes from excessive burning of fossil fuels. They produce carbon dioxide (CO₂), a greenhouse gas responsible for global warming. In this light, governments globally are framing policies to curb such carbon emissions. However, merely curbing carbon emissions may not be enough. Managing the generated carbon dioxide is also necessary. On this front, scientists have suggested chemically converting CO₂ into value-added compounds, such as methanol and formic acid (HCOOH). Producing the latter requires a source of hydride ion (H⁻), which is equivalent to one proton and two electrons. For instance, the nicotinamide adenine dinucleotide (NAD⁺/NADH) reduction-oxidation couple is a hydride (H⁻) generator and reservoir in biological systems. Against this backdrop, a group of researchers led by Professor Hitoshi Tamiaki from Ritsumeikan University, Japan, have now developed a novel chemical method that reduces CO₂ to HCOOH using NAD⁺/NADH-like ruthenium complexes. Prof. Tamiaki explains the motivation behind their research. "Recently, a ruthenium complex with an NAD⁺ model -- [Ru(bpy)₂(pbn)](PF₆)₂ -- was shown to undergo photochemical two-electron reduction. It produced the corresponding NADH-type complex [Ru(bpy)₂(pbnHH)](PF₆)₂ under visible light irradiation in the presence of triethanolamine in acetonitrile (CH₃CN)," he elaborates. "Further, the bubbling of CO₂ into the [Ru(bpy)₂(pbnHH)]²⁺ solution regenerated [Ru(bpy)₂(pbn)]²⁺ and produced formate ion (HCOO⁻). However, its yield was quite low. Therefore, transferring H⁻ to CO₂ required an improved catalytic system." Consequently, the researchers explored various reagents and reaction conditions to facilitate CO₂ reduction. Based on those experiments, they proposed a photoinduced two-electron reduction of the [Ru(bpy)₂(pbn)]²⁺/[Ru(bpy)₂(pbnHH)]²⁺ redox couple in the presence of 1,3-dimethyl-2-phenyl-2,3-dihydro-1H-benzo[d]imidazole (BIH). Moreover, water (H₂O), instead of triethanolamine, in CH₃CN further improved the yield. In addition, the researchers explored the underlying reaction mechanism using techniques like nuclear magnetic resonance, cyclic voltammetry, and UV-Vis spectrophotometry. Based on this, they proposed the following: First, the photo-excitation of [Ru(bpy)₂(pbn)]²⁺ produces [Ru^{III}(bpy)₂(pbn[•])]²⁺ radical, which undergoes reduction by BIH to give [Ru^{II}(bpy)₂(pbn[•])]²⁺ and BIH^{•+}. Following this, H₂O protonates the ruthenium complex, generating [Ru(bpy)₂(pbnH[•])]²⁺ and BI[•]. The obtained product undergoes disproportionation to generate [Ru(bpy)₂(pbnHH)]²⁺ and gives back [Ru(bpy)₂(pbn)]²⁺. Then, the former is reduced by BI[•] to produce [Ru(bpy)₂(pbn[•])(pbnHH)]⁺. This complex is an active catalyst and transfers H⁻ to CO₂, producing HCOO⁻ and formic acid. The researchers showed that the proposed reaction demonstrated a high turnover number -- moles of CO₂ converted by a mole of catalyst -- of 63. Excited by these findings, the researchers hope to develop a new methodology of energy conversion (sunlight to chemical energy) for the production of novel renewable materials. "Our method would also decrease the total amount of CO₂ gas on Earth and help maintain the carbon cycle. Thus, it could reduce global warming in the future," adds Prof. Tamiaki. "Further, the novel organic hydride transfer technology will provide us with invaluable chemical compounds."

Source <https://www.sciencedaily.com/releases/2023/02/230209094129.htm>

Electrical Engineering

5. Novel Microscope Developed to Design Better High-Performance Batteries

Lithium-ion batteries have transformed everyday lives -- almost everyone has a smartphone, more electric vehicles can be spotted on the roads, and they keep power generators going during emergencies. As more portable electronic devices, electric vehicles and large-scale grid implementations come online, the demand for higher energy density batteries that are safe and affordable continues to grow. Now, a University of Houston research team, in collaboration with researchers from the Pacific Northwest National Laboratory and the U.S. Army Research Laboratory, has developed an operando reflection interference microscope (RIM) that provides a better understanding of how batteries work, which has significant implications for the next generation of batteries. "We have achieved real-time visualization of solid electrolyte interphase (SEI) dynamics for the first time," said Xiaonan Shan, assistant professor of electrical and computer engineering at UH's Cullen College of Engineering and corresponding author of a study "This provides key insight into the rational design of interphases, a battery component that has been the least understood and most challenging barrier to developing electrolytes for future batteries." The highly sensitive microscope allows researchers to study the SEI layer, which is an extremely thin and fragile layer on the battery electrode surface that determines battery performance. Its chemical composition and morphology are continuously changing -- making it a challenge to study.

"A dynamic, non-invasive and high sensitivity operando imaging tool is required to understand the formation and evolution of SEI. Such a technique capable of direct probing SEI has been rare and highly desirable," said Yan Yao, the Hugh Roy and Lillie Cranz Cullen Distinguished Professor of electrical and computer engineering who has worked with Shan on this project for the last four years. "We have now demonstrated that RIM is the first of its kind to provide critical insight into the working mechanism of the SEI layer and help design better high-performance batteries," said Yao, who is also the principal investigator of the Texas Center for Superconductivity at the University of Houston. The research team applied the principle of interference reflection microscopy in the project, where the light beam -- centering at 600 nanometers with spectrum width of about 10 nanometers -- was directed towards the electrodes and SEI layers and reflected. The collected optical intensity contains interference signals between different layers, carrying important information about the evolution process of SEI and allowing the researchers to observe the entire reaction process. "The RIM is very sensitive to surface variations, which enables us to monitor the same location with large-scale high spatial and temporal resolution," said UH graduate student Guangxia Feng, who performed much of the experimental work on the project. The researchers note that most battery researchers currently use cryo-electron microscopes, which only take one picture at a certain time and cannot continuously track the changes at the same location. "I wanted to approach energy research from a different angle by adapting and developing new characterization and imaging methods which provide new information to understand the reaction mechanism in energy conversion processes," said Shan, who specializes in developing imaging techniques and spectrometry techniques to study electrochemical reactions in energy storage and conversions. This new imaging technique could also be applied to other state-of-the-art energy storage systems. "To realize the next generation of batteries, it is essential to understand the reaction mechanisms and novel materials," she said, adding that developing higher energy batteries also benefits the environment.

Source <https://www.sciencedaily.com/releases/2023/02/230209141509.htm>

Electronics and Communication Engineering

6. AST SpaceMobile Makes History in Cellular Connectivity, Completing the First-Ever Space-Based Voice Call Using Everyday Unmodified Smartphones

AST SpaceMobile, Inc. the company building the first and only space-based cellular broadband network accessible directly by standard mobile phones, recently announced the successful completion of the first-ever two-way voice calls, directly to everyday unmodified smartphones using the BlueWalker 3 (“BW3”) satellite. This is the first time anyone has ever achieved a direct voice connection from space to everyday cellular devices, demonstrating a significant advancement in AST SpaceMobile’s mission to provide connectivity to the nearly 50% of the global population who remain unconnected from cellular broadband. The first voice call was made from the Midland, Texas area to Rakuten in Japan over AT&T spectrum using a Samsung Galaxy S22 smartphone. The initial test calls have validated the AST SpaceMobile patented system and architecture, and were completed using unmodified smartphones. The calls demonstrated the power of AST SpaceMobile’s BW3 satellite, the largest-ever commercial communications array deployed in low Earth orbit and is an important step to providing space-based 2G, 3G, 4G LTE and 5G cellular broadband globally. Engineers from Vodafone, Rakuten and AT&T participated in the preparation and testing of the first voice calls with BW3. In addition to test calls, AST SpaceMobile engineers conducted initial compatibility tests on a variety of smartphones and devices. The phones successfully exchanged Subscriber Identification Module (“SIM”) and network information directly to BW3 -- crucial for delivering broadband connectivity from space to any phone or device. Additional testing and measurements on the smartphone uplink and downlink signal strength confirm the ability to support cellular broadband speeds and 4G LTE / 5G waveforms. AST SpaceMobile has over 2,600 patent and patent-pending claims for its technology and built state-of-the-art facilities in Midland, Texas that collectively span 185,000 square feet. AST SpaceMobile has agreements and understandings with mobile network operators globally that have approximately 2 billion existing subscribers, including Vodafone Group, Rakuten Mobile, AT&T, Bell Canada, Orange, Telefonica, TIM, Saudi Telecom Company, Zain KSA, Etisalat, Indosat Ooredoo Hutchison, Smart Communications, Globe Telecom, Millicom, Smartfren, Telecom Argentina, Telstra, Africell, Liberty Latin America and others. AST SpaceMobile is building the first and only global cellular broadband network in space to operate directly with standard, unmodified mobile devices based on our extensive IP and patent portfolio. The engineers and space scientists are on a mission to eliminate the connectivity gaps faced by today’s five billion mobile subscribers and finally bring broadband to the billions who remain unconnected. The ongoing testing of the BW3 test satellite may not be completed due to a variety of factors, which could include loss of satellite connectivity, destruction of the satellite, or other communication failures, and even if completed as planned, the BW3 testing may indicate adjustments that are needed or modifications that must be made, any of which could result in additional costs, which could be material, and delays in commercializing our service. If there are delays or issues with additional testing, it may become more costly to raise capital, if we are able to do so at all. AST SpaceMobile cautions that the foregoing list of factors is not exclusive. Mr Sriram Jayasimha, FNAE is Chief Scientist, Commercial Applications, AST SpaceMobile

Source <https://www.businesswire.com/news/home/20230425005532/en/AST-SpaceMobile-Makes-History-in-Cellular-Connectivity-Completing-the-First-Ever-Space-Based-Voice-Call-Using-Everyday-Unmodified-Smartphones>

Aerospace Engineering

7. SSLV-D2 Rocket with 3 Satellites Lifts Off from Sriharikota



This is LV D2's second developmental flight.

SSLV-D2 Launch: The Indian Space Research Organisation (ISRO) successfully launched the Small Satellite Launch Vehicle (SSLV-D2) from Satish Dhawan Space Centre at Sriharikota on February 10, 2023 morning. The launch vehicle carries three satellites including ISRO's earth observation satellite EOS-07 and two co-passenger satellites, namely, Janus-1 and AzaadiSat2. The three satellites have already been injected into the intended 450-km circular orbit around the Earth. This is LV D2's second developmental flight. The maiden flight which was carried on August 7 in 2022, was a partial failure. The maiden flight failed because of an orbit anomaly and some deviation in the rocket's flight path. For those unaware, the key features of SSLV include low-cost access to space, offers low turn-around time and flexibility in accommodating multiple satellites, and demands minimal launch infrastructure. The Earth Observation Satellite, EOS-07, is of 156.3 kg which has been designed, developed and realized by ISRO. The co-passenger satellite, Janus-1, is a 10.2 kg satellite which belongs to ANTARIS, USA. Another co-passenger satellite AzaadiSAT-2 is of 8.7 kg which was made a combined effort of about 750 girl students across India guided by Space Kidz India, Chennai, as per ISRO's official website.

SSLV-D2 vehicle characteristics:

SSLV, as per ISRO, is configured with three solid propulsion stages and a velocity terminal module. It is a 34 m tall, 2 m diameter vehicle having a lift-off mass of 120 t.

Vehicle Height: 34 m

Vehicle Diameter: 2 m

Lift off Mass: ~119 t

Vehicle Configuration: SS1 + SS2 + SS3 + VTM

SSLV-D2 Mission Specifications:

Altitude (km): 450

Inclination (deg): 37.2

Launch Pad: FLP

Source <https://www.financialexpress.com/defence/isro-sslv-d2-rocket-launch-sslvs-carrying-three-satellites-lifts-off-from-sriharikota/2977315/>

Mining, Metallurgical and Materials Engineering

8. Researchers Detail Never-Before-Seen Properties in a Family of Superconducting Kagome Metals

Dramatic advances in quantum computing, smartphones that only need to be charged once a month, trains that levitate and move at superfast speeds. Technological leaps like these could revolutionize society, but they remain largely out of reach as long as superconductivity -- the flow of electricity without resistance or energy waste -- isn't fully understood. One of the major limitations for real-world applications of this technology is that the materials that make superconducting possible typically need to be at extremely cold temperatures to reach that level of electrical efficiency. To get around this limit, researchers need to build a clear picture of what different superconducting materials look like at the atomic scale as they transition through different states of matter to become superconductors. Scholars in a Brown University lab, working with an international team of scientists, have moved a small step closer to cracking this mystery for a recently discovered family of superconducting Kagome metals. In a new study, they used an innovative new strategy combining nuclear magnetic resonance imaging and a quantum modeling theory to describe the microscopic structure of this superconductor at 103 degrees Kelvin, which is equivalent to about 275 degrees below 0 degrees Fahrenheit. The researchers described the properties of this bizarre state of matter for what's believed to be the first time. Ultimately, the findings represent a new achievement in a steady march toward superconductors that operate at higher temperatures. Superconductors that can operate at room temperature (or close to it) are considered the holy grail of condensed-matter physics because of the tremendous technological opportunities they would open in power efficiency, including in electricity transmission, transportation and quantum computing. The new study focuses on superconductor RbV₃Sb₅, which is made of the metals rubidium vanadium and antimony. The material earns its namesake because of its peculiar atomic structure, which resembles a basketweave pattern that features interconnected star-shaped triangles. Kagome materials fascinate researchers because of the insight they provide into quantum phenomena, bridging two of the most fundamental fields of physics -- topological quantum physics and condensed matter physics.

Previous work from different groups established that this material goes through a cascade of different phase transitions when the temperature is lowered, forming different states of matter with different exotic properties. When this material is brought to 103 degrees Kelvin, the structure of lattice changes and the material exhibits what's known as a charge-density wave, where the electrical charge density jumps up and down. Understanding these jumps is important for the development of theories that describe the behaviour of electrons in quantum materials like superconductors. What hadn't been seen before in this type of Kagome metal was what the physical structure of this lattice and charge order looked like at the temperature the researchers were looking at, which is highest temperature state where the metal starts transitioning between different states of matter. Using a new strategy combining NMR measurements and a modeling theory known as density functional theory that's used to simulate the electrical structure and position of atoms, the team was able to describe the new structure the lattice changes into and its charge-density wave. They showed that the structure moves from a 2x2x1 pattern with a signature Star of David pattern to a 2x2x2 pattern. This happens because the Kagome lattice inverts in on itself when the temperature gets extremely frigid. The new lattice it transitions into is made up largely of separate hexagons and triangles, the researchers showed. They also showed how this pattern connects when they take one plane of the RbV₃Sb₅ structure and rotate it, "gazing" into it from a different angle. Probing this atomic structure is a necessary step to providing a complete portrait of the exotic states of matter this superconducting material transitions into, the researchers said. They believe the findings will lead to further prodding on whether this formation and its properties can help superconductivity or if it's something that should be suppressed to make better superconductors. The new unique technique they used will also allow the researchers to answer a whole new set of questions.

Source <https://www.sciencedaily.com/releases/2023/02/230210185152.htm>

Energy Engineering

9. Research Reveals Thermal Instability of Solar Cells but Offers a Bright Path Forward

A new type of solar technology has seemed promising in recent years. Halide perovskite solar cells are both high performing and low cost for producing electrical energy -- two necessary ingredients for any successful solar technology of the future. But new solar cell materials should also match the stability of silicon-based solar cells, which boast more than 25 years of reliability. A team led by Juan-Pablo Correa-Baena, assistant professor in the School of Materials Sciences and Engineering at Georgia Tech, shows that halide perovskite solar cells are less stable than previously thought. Their work reveals the thermal instability that happens within the cells' interface layers, but also offers a path forward towards reliability and efficiency for halide perovskite solar technology. Their research has immediate implications for both academics and industry professionals working with perovskites in photovoltaics, a field concerned with electric currents generated by sunlight. Lead halide perovskite solar cells promise superior conversion of sunlight into electrical power. Currently, the most common strategy for coaxing high conversion efficiency out of these cells is to treat their surfaces with large positively charged ions known as cations. These cations are too big to fit into the perovskite atomic-scale lattice, and, upon landing on the perovskite crystal, change the material's structure at the interface where they are deposited. The resulting atomic-scale defects limit the efficacy of current extraction from the solar cell. Despite awareness of these structural changes, research on whether the cations are stable after deposition is limited, leaving a gap in understanding of a process that could impact the long-term viability of halide perovskite solar cells. To carry out the experiment, the team created a sample solar device using typical perovskite films. The device features eight independent solar cells, which enables the researchers to experiment and generate data based on each cell's performance. They investigated how the cells would perform, both with and without the cation surface treatment, and studied the cation-modified interfaces of each cell before and after prolonged thermal stress using synchrotron-based X-ray characterization techniques. First, the researchers exposed the pre-treated samples to 100 degrees Celsius for 40 minutes, and then measured their changes in chemical composition using X-ray photoelectron spectroscopy. They also used another type of X-ray technology to investigate precisely what type of crystal structures form on the film's surface. Combining the information from the two tools, the researchers could visualize how the cations diffuse into the lattice and how the interface structure changes when exposed to heat. Next, to understand how the cation-induced structural changes impact solar cell performance, the researchers employed excitation correlation spectroscopy in collaboration with Carlos Silva, professor of physics and chemistry at Georgia Tech. The technique exposes the solar cell samples to very fast pulses of light and detects the intensity of light emitted from the film after each pulse to understand how energy from light is lost. The measurements allow the researchers to understand what kinds of surface defects are detrimental to performance. Finally, the team correlated the changes in structure and optoelectronic properties with the differences in the solar cells' efficiencies. They also studied the changes induced by high temperatures in two of the most used cations and observed the differences in dynamics at their interfaces. The researchers learned that the surfaces of metal halide perovskite films treated with organic cations keep evolving in structure and composition under thermal stress. They saw that the resulting atomic-scale changes at the interface can cause a meaningful loss in power conversion efficiency in solar cells. In addition, they found that the speed of these changes depends on the type of cations used, suggesting that stable interfaces might be within reach with adequate engineering of the molecules.

Source <https://www.sciencedaily.com/releases/2023/02/230209224439.htm>

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

10. Researchers Develop New, Automated, Powerful Diagnostic Tool for Drug Detection

In recent years, a mass spectrometry process that can detect the amounts of drugs in a biological sample, such as blood, has become a powerful diagnostic tool for helping medical professionals identify and monitor levels of therapeutic drugs in patients, which can cause unwanted or dangerous side effects. Holding back this technique -- which is called liquid chromatography tandem mass spectrometry or LC-MS/MS for short -- is that it often requires relatively large biological samples and a number of complicated steps that must be done by hand to prepare samples for analysis. At Brown University, a team of biomedical engineers has been working to make this time-consuming process simpler and much more automated, a key ingredient to the technique being widely adopted by clinicians. In the study, they present a robust new method for accurately measuring and identifying eight antidepressants most commonly prescribed to women: bupropion, citalopram, desipramine, imipramine, milnacipran, olanzapine, sertraline and vilazodone. The method does just what the researchers hoped. It is able to identify and monitor these drugs from small biological samples -- 20 microliters each, which is about the equivalent of blood taken from a prick. The method is also able to be done almost entirely by liquid-handling robots found in most clinical mass spectrometry labs. Once the samples are ready, the user puts them through the mass spectrometer, which breaks the sample down into tiny fragments that contain tell-tale signs of the drugs they are looking for. The method's accuracy is comparable to other LC-MS/MS-based techniques but has the advantage of a much smaller sample size and is able to be largely automated using the liquid handlers. These innovations set up the system's immediate potential to be widely translated to clinical settings to help monitor the impacts of drugs prescribed for patients diagnosed with depression, including women experiencing postpartum depression. Depression is a growing global crisis, and women face higher rates of diagnosis than men. The percentage of patients prescribed antidepressants has tripled over the past two decades, and clinicians find themselves at a crossroad between finding the right drug to suit a patient and monitoring the abundance of it in the body, the researchers wrote in the study. Currently, there are no commercial products in the U.S. to help clinicians directly monitor how much these drugs are present in patients, the researchers noted. Clinicians often end up relying on more qualitative methods, like surveys, because of how obtrusive mass spectrometry methods are to patients in terms of sample size and the time-consuming nature of preparing the samples for the machine. Tripathi and colleagues in his lab started working on this potential solution in 2021 after they were asked to evaluate a commercial European kit that uses LC-MS/MS to detect drugs in humans. The work has largely been the result of a collaboration between Brown graduate and undergraduate students who work in the lab. The researchers decided to take a crack at designing their own kit that could be just as accurate but much simpler. They started by identifying some of the most commonly used depressants and from there worked to refine the how the LC-MS/MS technique identifies the drugs, including how much of a sample it needs and establishing a control they could run against actual samples. After running a barrage of quality control checks, tweaking and testing different methods of measuring the samples at different conditions, the researchers took their entire process for preparing the sample and broke it down so that it could be programmed into a machine that could handle the preparation of the liquids. The Brown researchers used a JANUS G3 Robotic Liquid Handler in their work but said that clinicians can use simpler or more advanced machines. The team detailed how they programmed their machine in a way that others can easily replicate with their own equipment. The team also created prototype kits that can be sent to clinicians, so they can implement the method in their labs. The kits include the chemicals and solvents needed along with a detailed instruction booklet that calls out what clinicians should be on the lookout for based on their own experiences and the numerous tweaks they made during quality control process..

Source <https://www.sciencedaily.com/releases/2023/02/230210185142.htm>

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ENGINEERING INNOVATION IN INDIA

IISER Bhopal Researchers Develop Organic Crystalline Materials for Highly Sensitive Pressure Sensors



Flexible organic crystal piezo resistive materials such as Indian Institute of Science Education and Research Bhopal researchers have successfully developed a new, flexible organic crystal that shows great potential for use in highly sensitive pressure sensors. These crystals were developed in IISER Bhopal, and the understanding of the response of these crystals to mechanical deformation was done in collaboration with researchers from the University of Queensland and the Queensland University of Technology. The device fabricated with this material has a high sensitivity to pressure, when compared to existing materials, making it a promising component for the future development of the technology of pressure sensors. There is a growing interest in the use of organic materials for electronic applications. The flexibility of organic materials makes them ideal for creating flexible electronic devices such as displays and sensors that can be bent or curved, providing a new level of design freedom. Organic crystals, in particular, have immense potential in the field of electronics, due to their few defects and minimal grain boundaries. The researchers from IISER Bhopal and University of Queensland have developed a new organic crystal – 4-trifluoromethyl phenyl isothiocyanate (4CFNCS) – that is flexible enough to be bent, twisted, and coiled. Speaking about the research, Professor Deepak Chopra, Department of Chemistry, IISER Bhopal, said, “We thoroughly analyzed 4CFNCS using sophisticated computational and challenging experimental techniques such as synchrotron microfocus X-ray diffraction measurements to understand as to why these are so flexible.” The analysis of the crystal structure showed that the way the atoms of this molecule are arranged in solids allows it to bend and stretch without breaking when subjected to mechanical stress. This helps to keep the crystal structure intact even under high pressure and impact. The slippage of molecules in multiple directions enables complex coiling motion in crystals. Not only have the researchers uncovered the origin of flexibility in this new type of organic crystal, but they have also successfully used it to fabricate highly sensitive pressure sensors. Piezo-resistive or pressure sensors are devices that respond to pressure or force applied to them by a change in their electrical resistance. For example, piezo-resistive sensors are typically located behind the touch surface of any touch device and are activated when pressure is applied to the surface during touch. This generates a small electrical charge that is then processed. The collaborative team combined 4CFNCS with an electrically conducting polymer, PEDOT: PSS, to make the piezo-resistive sensor. “The composite developed using the researchers exhibited efficient piezo-resistive response, even at high-pressure ranges, resulting in at least 1.6-times improvement in sensitivity for medium pressure range, and at least 5 times in the high-pressure range across a wide range of pressures, over other known piezo-resistive materials,” said Prof. Deepak Chopra. Flexible organic crystal piezo resistive materials such as the one developed by the team are attractive because they are sustainable and easy to work with.

Source <https://timesofindia.indiatimes.com/gadgets-news/iiser-bhopal-researchers-develop-organic-crystalline-materials-for-highly-sensitive-pressure-sensors/articleshow/97146827.cms>

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

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