INDIAN NATIONAL ACADEMY OF ENGINEERING

E-Newsletter

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INAE VISION 2020-2025

INAE VISION

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

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INAE Mission

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

Technology Roadmap

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

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

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

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

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

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

Our engineering education has to be appropriately re-engineered so as to equip our future leaders with not only the domain expertise but also the skillsets to innovate continuously and consistently in the face

of constant change and dynamic transformations. The human ingenuity and the preparing the well-trained minds, will be critical ingredients in responding to the challenges ahead.

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

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

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

These materials will have to 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 ofresidence (particularly important for senior citizens living alone) through the intervention of digital connectivity, sensors and IoT solutions. Provision of healthcare and affordable Medicare facilities through technological interventions is a key focus area.

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

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ACADEMY ACTIVITIES

Academy News (Covering upto January 31, 2022)

Nominations/Proposals invited for:

- **Nominations for INAE Fellowship/Foreign Fellowship 2022.**

The process for receipt of nominations for INAE Fellowship and Foreign Fellowship, both online and offline is open. As a part of the on-going initiative of INAE to digitize as much of its operation as possible, kindly note that from the year 2020 onwards, nominations for election to the Fellowship of INAE are to be submitted online through a Digital Platform (using personal log-in credentials of the Fellows registered with INAE). However, as this is the third year of transition in exceptional circumstances, nominations can also be submitted as soft copy forwarded through email, if not feasible for submission through Digital Platform. The last date for receipt of nominations is March 31, 2022. For further details and to download soft copies of nomination forms please visit INAE website www.inae.in at the link https://www.inae.in/forms/

- **Mentoring of Engineering Teachers/Students by INAE Fellows**

From this year, new digital modules have been designed for the Mentoring Scheme for Engineering Students by INAE Fellows and Mentoring Scheme for Engineering Teachers by INAE Fellows which allows Engineering Students and Engineering Teachers to choose mentors from INAE Fellowship and apply directly for the scheme from INAE Website. All INAE Fellows and INAE Young Associates who have completed five years as Young Associates with INAE and in regular employment can give consent for mentoring through profile page so that the mentees may browse through the profiles of mentors before applying. Applications for mentoring of Engineering Students/Teachers were closed on **February 6, 2022**. The last date to evaluate the Applications received by the mentor and submit to INAE was **February 13, 2022**. An overwhelming response has been received from the student community and the final lists shall be announced after consideration by INAE Steering Committee/ Governing Council.

- **INAE Distinguished Professors/Technologists and INAE Chair Professorship**

INAE has two important schemes for INAE Fellows, namely INAE Distinguished Professors/Technologists and INAE Chair Professorship Schemes. INAE Distinguished Professors/Technologists scheme was instituted in 2005 with the objective to utilize the expertise of INAE Fellows after superannuation and those not in regular employment primarily for research in Institutions/Universities/Research & Development establishments and Industry in India. INAE Chair Professorship scheme was instituted in the year 2007 in order to encourage engineers/technologists with outstanding research contributions, promote long-term participation in academic research and enhance the research standards in academic institutions. The schemes were put on hold from the year 2020 onwards to review and improve the effectiveness and outreach of the subject schemes. After deliberations, the Guidelines of the above-mentioned schemes have been revised by the INAE Governing Council to be effective from the year 2022 onwards and the schemes are being reinstated. Applications for the year 2022 for both the schemes were invited from the Fellows of the Academy. The last date of receipt of nominations under both the schemes was **February 9, 2022.**

The final selections shall be announced after the Governing Council meeting being scheduled in March 2022.

- **INAE Young Innovator & Entrepreneur Award 2022**

The call for nominations is now open for the prestigious INAE Young Innovator & Entrepreneur Award 2022 which was instituted in 2017. The nominations are sought from INAE Fellows and Heads of

Organizations (Industry, Business Houses, R&D organizations, Academic Institutions, and Government Agencies/Department). The award carries a certificate and a cash prize of Rs 2 lakhs. A maximum of four awards can be given every year. The cut-off date of receipt of nominations has been rescheduled to be sought latest **by April 30, 2022**. For more details, please visit Events section on INAE website www.inae.in

- **INAE-SERB Abdul Kalam Technology Innovation National Fellowship**

INAE and Science and Engineering Research Board (SERB), Department of Science and Technology (DST) had jointly 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. A total of thirty-seven nominees have been conferred the subject Fellowship so far. The duration of the fellowship will be initially for three years, extendable by upto two more years depending on the performance. The fellowship can be held for a maximum of 5 years. A financial support of upto Rs 19 lakhs per annum is given to the selected fellows towards research grant, honorarium and overhead expenses. The cut-off date of receipt of nominations for this Financial Year is **June 30, 2022**. For more details, please visit INAE website https://www.inae.in/research-innovation/abdul-kalam-technology-innovation-national-fellowship-2019-20/

- **INAE Expert Groups**

Proposals are being invited from INAE Fellows for the INAE Expert Groups. INAE had instituted "INAE Expert Groups" to Prepare Technology Roadmaps with Actionable Recommendations with the objective of developing a comprehensive technology road map with actionable recommendations on selected engineering themes or domains to help the country (Government, funding agencies, educational institutions, research organizations, industry and users) formulate a policy, strategy and/or roadmap for implementation. The cut-off date of receipt of proposals was **February 6, 2022.**

The final selections shall be announced after the Governing Council meeting scheduled in March 2022.

Meetings and Events

INAE Annual Convention 2021

Indian National Academy of Engineering (INAE) organizes its Annual Convention every year, during the month of December. INAE Annual Convention is a mega event attended by Fellows, Foreign Fellows, Young Associates, Awardees and Invitees. INAE Annual Convention 2021 was held online on December 16-18, 2021 due to unprecedented circumstances on account of COVID pandemic all over the world. The Inaugural function was held on December 16, 2021 which commenced with the lighting of the lamp by the dignitaries on the dais viz. Prof Indranil Manna, President, INAE; Prof Purnendu Ghosh, Vice-President (Finance& Establishment), INAE; Prof AB Pandit Vice- President (Academic, Professional & International Affairs), INAE; Prof Sivaji Chakravorti, Vice-President (Fellowship, Awards & Corporate Communication), INAE and Prof K Bhanu Sankara Rao, Chief Editor of Publications, INAE followed by the delivery of the Presidential Address by Prof Indranil Manna, President, INAE.

Lighting of the lamp by the dignitaries on the dais, (From left to right) Prof Sivaji Chakravorti, Vice-President, INAE, Prof K Bhanu Sankara Rao, Chief Editor of Publications, INAE, Prof Purnendu Ghosh & Prof AB Pandit, Vice-Presidents, INAE, Dr PS Goel, former President, INAE, Prof Indranil Manna, President, INAE and Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE.

Presidential Address delivered by Prof Indranil Manna, President, INAE

During the Inaugural function, a Book titled “Making of a Satellite Centre: The Genesis of ISRO's UR Rao Satellite Centre” authored by Dr Prem Shanker Goel, former President, INAE and former Secretary, Ministry of Earth Sciences and Chairman, Earth Commission and Director, ISRO Satellite Centre, Bangalore was released. Mr NR Narayana Murthy, Formerly Chairman Emeritus, Infosys Ltd. was the Chief Guest at the Inaugural Function. His talk was on the topic “Creating a culture to solve grand engineering challenges of India” which was very keenly listened to by the audience. During his address he highlighted that young researchers should try to solve the Grand Challenges of India. The Inaugural function concluded with the proposing of the vote of thanks by Prof Purnendu Ghosh, Vice-President, INAE. The video recording of the Inaugural Function can be viewed by clicking on the link https://www.youtube.com/watch?v=rstLSiYkP-U.

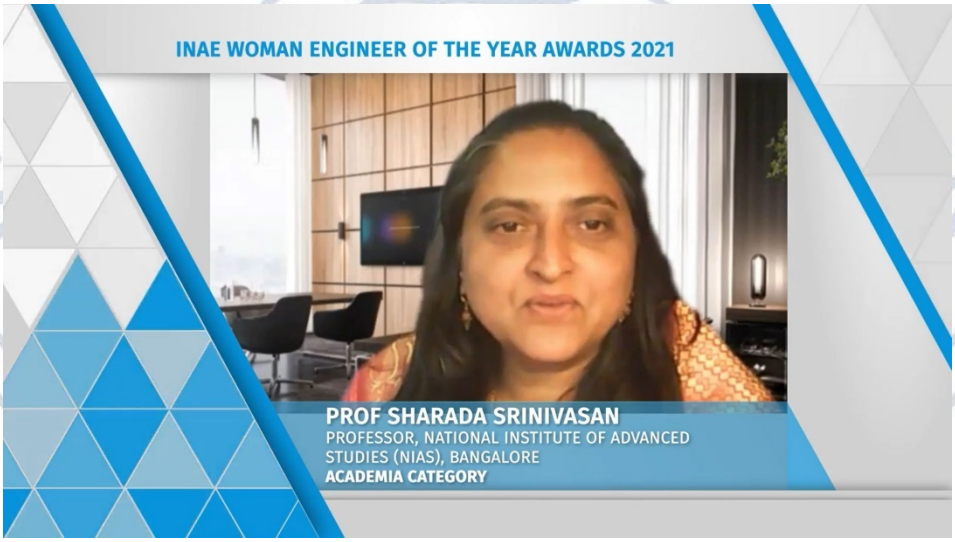
Release of the Book "Making of a Satellite Centre: The Genesis of ISRO's URSC" by Dr PS Goel, former President, INAE

Mr NR Narayana Murthy, Formerly Chairman Emeritus, Infosys Ltd., the Chief Guest at the Inaugural Function delivered the Lecture on "Creating a culture to solve grand engineering challenges of India"

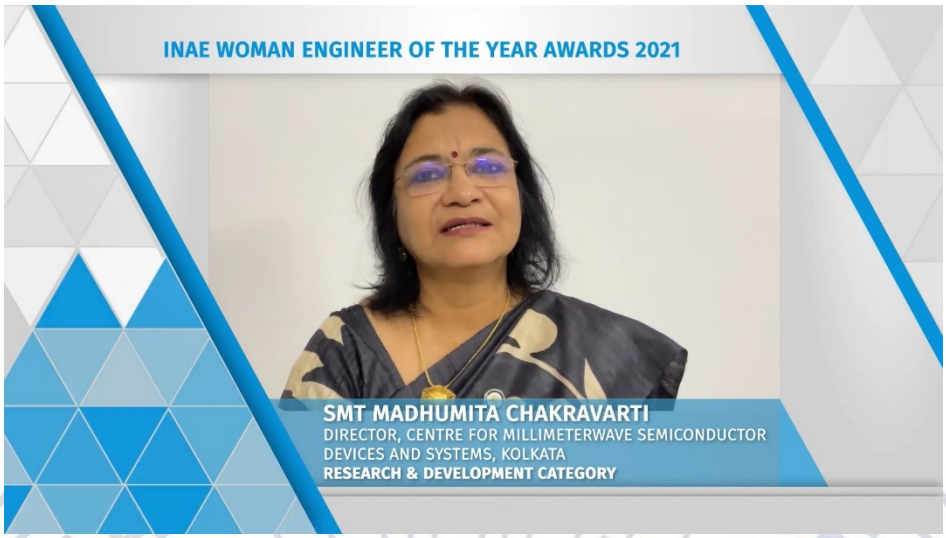
Vote of Thanks proposed by Prof Purnendu Ghosh, Vice-President, INAE

The Grand Award Function was held on December 16, 2021 from 12.00 Noon onwards, wherein various awards viz. INAE Women Engineer of the Year Award, INAE Outstanding Teachers Award, Prof Jai Krishna and Prof SN Mitra Memorial Awards and Life Time Contributions Award instituted by the Academy were conferred electronically. After that, announcement and Award Presentation of Innovative Student Projects Awards at Doctoral, Masters and Bachelor's level, Youth Conclave winners, Innovation in Manufacturing Processes, Young Engineer awardees and Young Innovator & Entrepreneur Award were held. The video recording of the Grand Award Function can be viewed by clicking on the link https://www.youtube.com/watch?v=uszfJhtQrQQ.

INAE Women of the Year Award 2021 was awarded in three categories, Academia, R&D and Industry. Ms Vartika Shukla, CMD, Engineers India Limited, Delhi, the Woman Engineer of the Year Awardee 2021 (Industry Category) delivering her award acceptance speech.

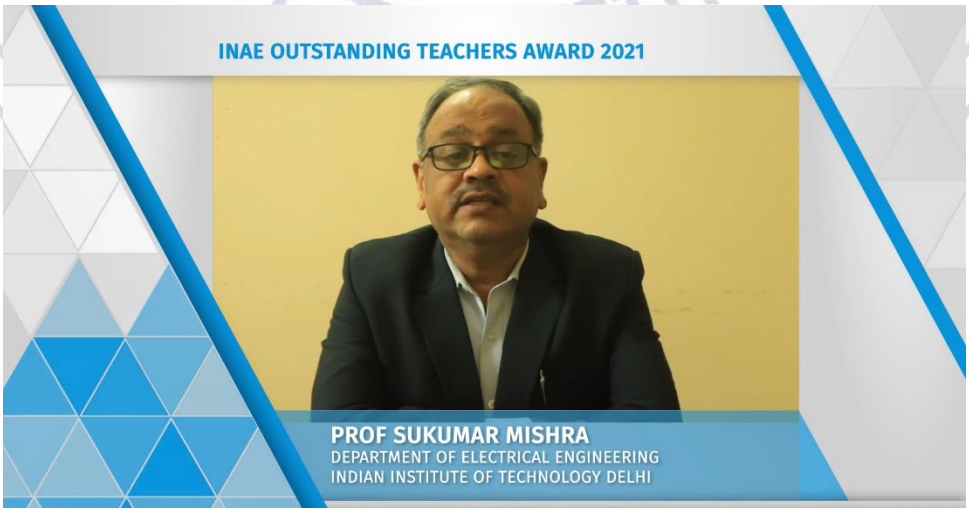


Prof Sharada Srinivasan, NIAS, Bangalore, the Woman Engineer of the Year Awardee 2021 (Academia Category) delivering her award acceptance speech.

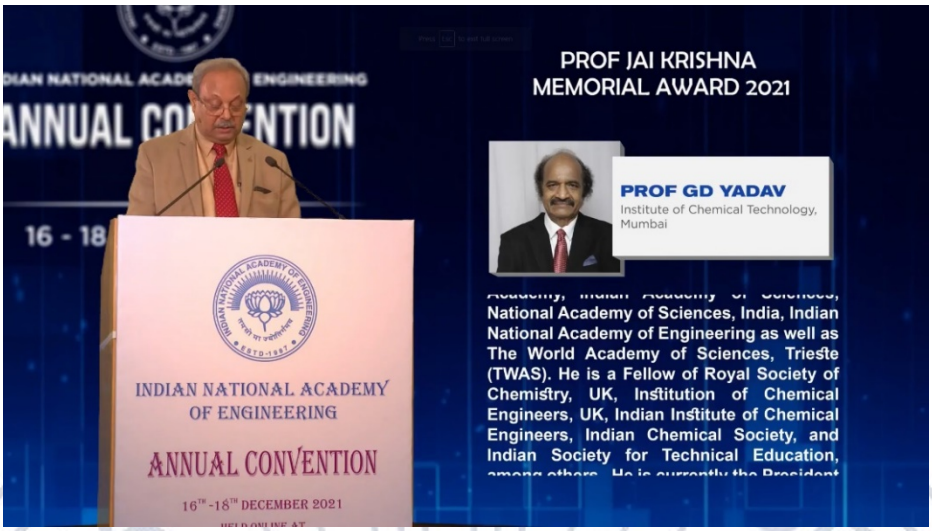


Smt Madhumita Chakravarti, Director, CMSDS, Kolkata, the Woman Engineer of the Year Awardee 2021 (R&D Category) delivering her award acceptance speech

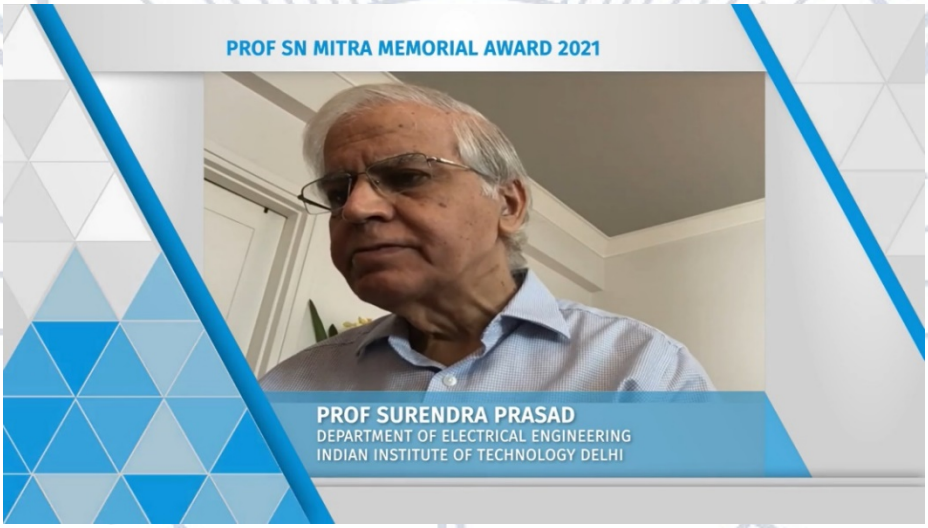
Prof Suman Chakraborty, Department of Mechanical Engineering, Indian Institute of Technology Kharagpur-INAE Outstanding Teachers Awardee for the year 2021 delivering his award acceptance speech.



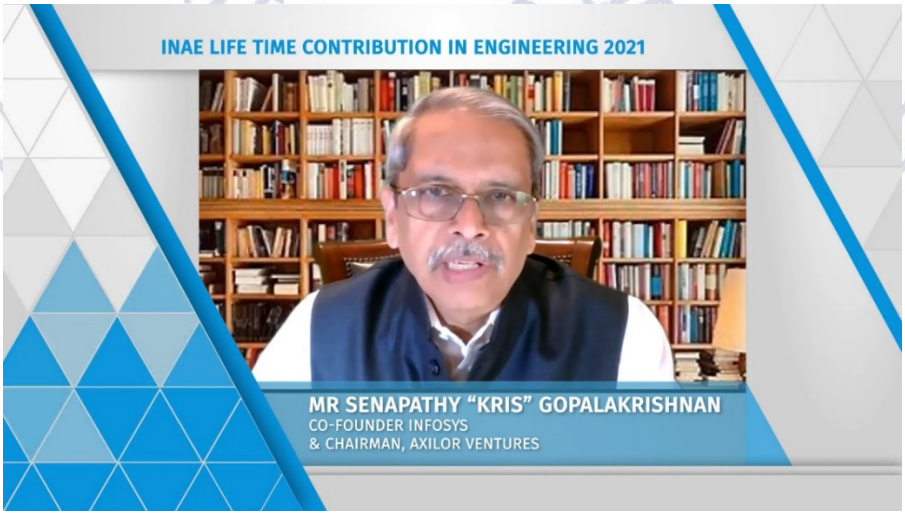
Prof Sukumar Mishra, Department of Electrical Engineering, Indian Institute of Technology Delhi-INAE Outstanding Teachers Awardee for the year 2021 delivering his award acceptance speech



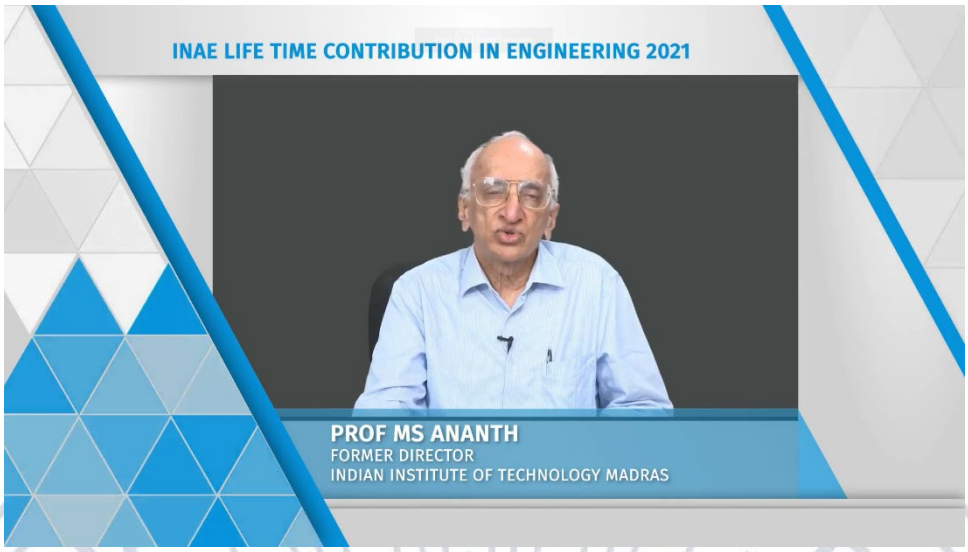
Prof Jai Krishna Memorial Award 2021 awarded to Prof GD Yadav, Emeritus Professor of Eminence and JC Bose National Fellow, Former Vice Chancellor; Institute of Chemical Technology, Mumbai



Prof Surendra Prasad, Department of Electrical Engineering, Indian Institute of Technology Delhi- Prof SN Mitra Memorial Award 2021 awardee delivering his award acceptance speech



Mr Senapathy 'Kris' Gopalakrishnan, Co-founder Infosys & Chairman Axilor Ventures – INAE Life Time Contribution Award in Engineering 2021 Awardee delivering his award acceptance speech



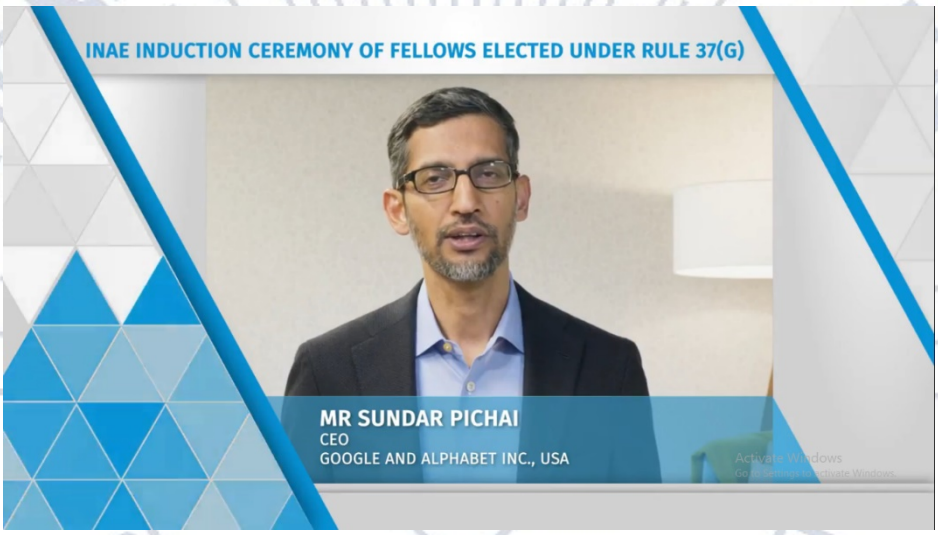
Prof MS Ananth, Emeritus Research Fellow, Department of Chemical Engineering, IIT Madras; and Former Director, Indian Institute of Technology Madras- INAE Life Time Contribution Award in Engineering 2021 Awardee delivering his award acceptance speech

The Award Lectures were held on December 16, 2021 at 4.30 PM during which the winners of the INAE Women Engineer of the Year Award, INAE Outstanding Teachers Award, Prof Jai Krishna and Prof SN Mitra Memorial Awards and Life Time Contributions Award in Engineering made presentations on their contributions that have been recognized and awarded. On the second day i.e., December 17, 2021 at 1.30 PM the Annual General Meeting (AGM) and Special General Meeting of Fellows (SGM) were held. The AGM was attended by INAE Fellows and INAE Young Associates and the SGM was attended by INAE Fellows only. The video recording of the Award Lectures can be viewed by clicking on the link https://www.youtube.com/watch?v=ZZe8xnt3BzQ.

On the last day i.e., December 18, 2021, the Induction Ceremony of Fellows & Young Associates was held at 7.30 AM followed by the Pre-recorded Technical Presentations by newly elected Fellows & Foreign Fellows by 44 newly inducted Fellows & Foreign Fellows in four parallel sessions on various topics related to engineering fields. The video recording of the Induction Ceremony of Fellows & Young Associates can be viewed by clicking on the link https://www.youtube.com/watch?v=UBVSork1hAA.

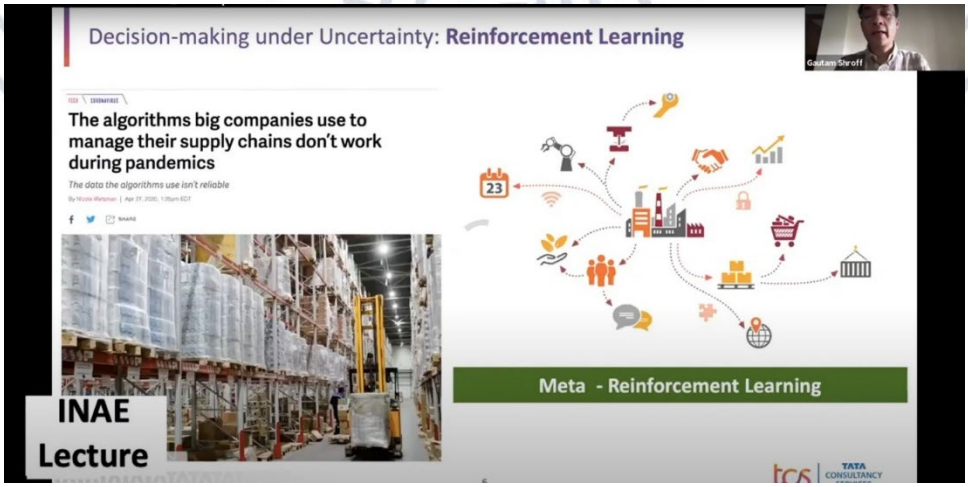
Prof David Jeffery Wineland, 2012 Nobel Prize in Physics, Philip Knight Distinguished Research Chair, Department of Physics, University of Oregon, US, inducted as Fellow of INAE

Mr Vikram Kirloskar, Chairman and Managing Director of Kirloskar Systems Ltd. and Vice Chairman of Toyota Kirloskar Motor inducted as Fellow of INAE.



Mr Sundar Pichai, CEO, Google and Alphabet Inc., USA inducted as Fellow of INAE

In the afternoon session on December 18, 2021 at 1.30 PM, Pre-recorded Technical Presentations on various topics by award winners of Young Engineer Award and Young Innovator & Entrepreneur Award were held. The event was widely attended online.



A Lecture on 'Decision-making under Uncertainty: Reinforcement Learning' by one of the newly elected Fellows, Dr Gautam Shroff.

The video recordings of the Technical Presentations by newly elected Fellows & Foreign Fellows (Four Parallel Sessions) held online on December 18, 2021 can be viewed by clicking on the links given below.

Parallel Sessions (Engineering Sections Group-1)- Parallel Sub-Session-1: Parallel Sub-Session-1 (ES-I, III and IV) https://www.youtube.com/watch?v=mJAajpB8gdc

Parallel Sessions (Engineering Sections Group-1)-Parallel Sub-Session-2 (ES-VII and VIII)
https://www.youtube.com/watch?v=rOn3dEVPsvU

Parallel Sessions (Engineering Sections Group-2)- Parallel Sub-Session-3 (ES-II, V and VI)
https://www.youtube.com/watch?v=5eu7w7y--Ik

Parallel Sessions (Engineering Sections Group-2)- Parallel Sub-Session-4 (ES-IX and X)
https://www.youtube.com/watch?v=AmR203R55tI

The video recording of the Technical Presentations by award winners of Young Engineer Award and Young Innovator & Entrepreneur Award (Two Parallel Sessions) held online on December 18, 2021 can be viewed by clicking on the links given below.

Parallel Session 1 (Engineering Sections Group-1) -Parallel Session 1 (ES-I, III, IV, VII and VIII)
https://www.youtube.com/watch?v=DyKaVFaToYo&t=74s

Parallel Session 2 (Engineering Sections Group-2) -Parallel Session 2 (ES-II, V, VI, IX and X)
https://www.youtube.com/watch?v=wILYQkLlXfk

Panel Discussion to "Review the role of nuclear energy in managing the transition to a low-carbon electricity mix in India"

The Panel Discussion to *"*Review the role of nuclear energy in managing the transition to a low-carbon electricity mix in India*"* was held online on 8th December 2021**.** The Panel Discussion was moderated by Prof. Indranil Manna, President, INAE and the list of esteemed Panellists is as under.

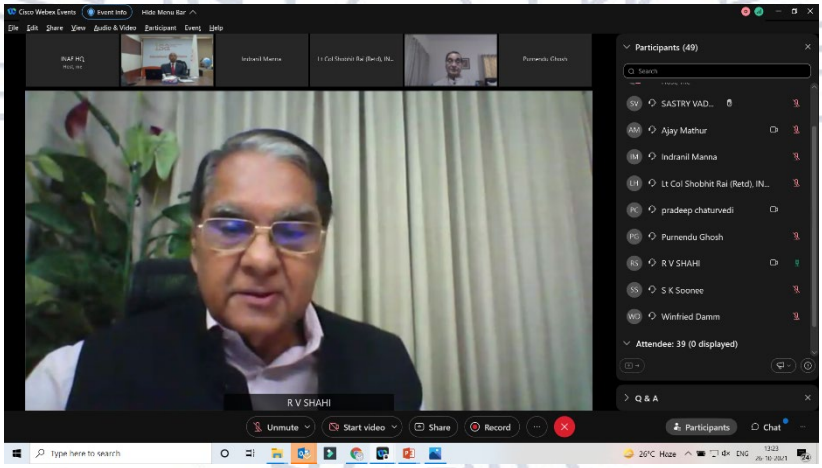
i. Dr. Anil Kakodkar, Former President INAE, AICTE Distinguished Chair Professor, Formerly Chairman, AEC & Secretary, GoI, DAE.
ii. Dr. RB Grover, Emeritus Professor, Homi Bhabha National Institute, Mumbai.
iii. Dr. Ajay Mathur, Director General, International Solar Alliance.
iv. Shri H. L. Bajaj, Former Chairman, Central Electricity Authority.
v. Mr Praveen Bhatt, GM & Head – Nuclear Eqpt & System, L&T Heavy Engineering
vi. Shri Kaushtuv Shukla, Executive Vice President & Business Head, Godrej & Boyce.
vii. Prof. Amit Garg, IIM, Ahmedabad.

Dr RB Grover made a pertinent presentation on "Role of Nuclear Energy in Decarbonization of Indian Energy Sector' whereas Mr Praveen Bhat spoke on "Nuclear Energy - Role in Managing the Transition to a Low-Carbon Electricity Mix in India". Prof Amit Garg made a presentation on the topic "India's Net Zero Commitment and Nuclear Power: Preliminary Results". The discussion was fruitful and focused and was appreciated by all participants. The recommendations emanating from the discussion meeting are given in the link.

INAE Engineers Conclave 2021

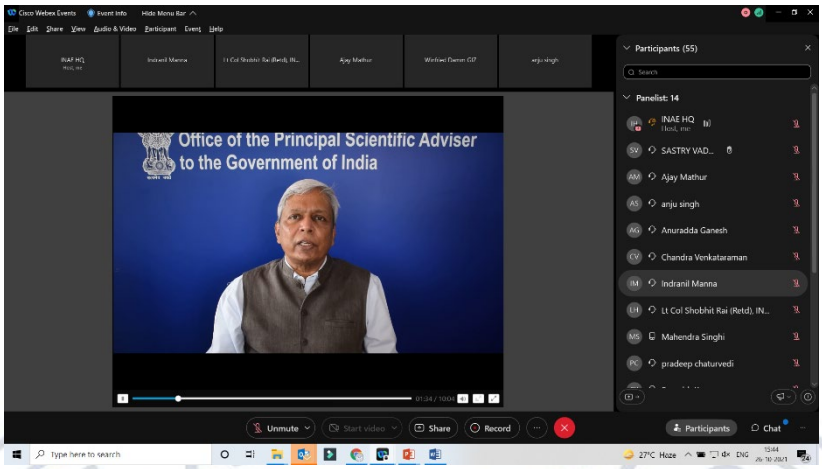
INAE organizes an annual mega event of engineers as "Engineers Conclave" jointly with major engineering organizations on rotation basis. The objective of the Engineers Conclave is to provide a platform for engineers and technologists from allied fields to meet, deliberate and recommend right engineering solutions to some of the pertinent issues of national importance. The Engineers Conclave has two themes, one pertinent to the host organization and the other related to social problem requiring engineering interventions coordinated by INAE. Last year, Engineers Conclave 2021 (EC-2021) was organized jointly online with the International Solar Alliance (ISA) on October 26-27, 2021. The two themes of EC-2021 were "Engineering challenges for de-carbonizing the Indian Economy" coordinated by ISA and "Achievements of Indian Engineering – Azadi ka Amrit Mahotsav" coordinated by INAE. Dr Ajay Mathur, DG, ISA and Prof Indranil Manna, President, INAE were the Co-Chairs of EC-2021. Prof AB Pandit, Vice-President, INAE was the overall Coordinator of the event. Shri VVR Sastry, FNAE and Shri Pradeep Chaturvedi, FNAE were the Coordinators of the event.

The Inaugural Session of the EC- 2021 was held on October 26, 2021. The Welcome address was delivered by Dr Ajay Mathur, DG, ISA & Co-Chair, EC -2021 followed by Presidential Address by Prof Indranil Manna, President, INAE. The inaugural address was delivered by the Chief Guest Shri RV Shahi, Former Secretary to the Government of India in the Ministry of Power. During his address he highlighted that it appears that we should succeed on our efforts on net zero emissions by 2050 – 2060 and the speed of various initiatives would depend on success in technology development, cost affordability, and management of operational constraints. The Inaugural Session concluded with Vote of Thanks by Shri Pradeep Chaturvedi, FNAE.



Inaugural Address delivered by the Chief Guest Shri RV Shahi, Former Secretary to the Government of India in the Ministry of Power

The highlights of the Conclave were two Plenary Talks, Distinguished Address by Prof K VijayRaghavan, Principal Scientific Advisor to the Govt. of India and address by eminent Session Chairs namely Shri Ajay Shankar, Distinguished Fellow, TERI; Shri Saurabh Kumar, MD, Energy Efficiency Services Limited (EESL); Dr Mangu Singh, MD, Delhi Metro Rail Corporation (DMRC); Prof AB Pandit, Vice-President, INAE & Vice-Chancellor, ICT, Mumbai; Dr U Kamachi Mudali, Vice-Chancellor, VIT Bhopal University and Shri VVR Sastry, Adjunct Professor, National Institute of Advanced Studies (NIAS), Bengaluru.



Distinguished Address by Prof K VijayRaghavan, the Principal Scientific Adviser to the Government of India

The first Plenary talk was delivered on October 26, 2021 by Lord Adair Turner, Chair, Energy Transitions Commission, UK on 'Global picture on scenarios to achieve 1.5 degrees and net zero'. The Second Plenary Talk was delivered on October 27, 2021 on "Dilemmas at the Intersection of Scientific Temper and Engineering Ethics" by Prof VM Naik, Department of Chemical Engineering, IIT Bombay.

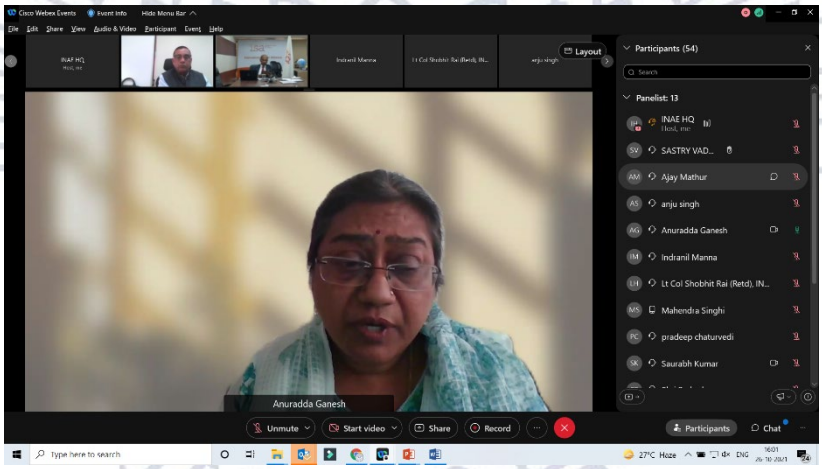
First Plenary Talk by Lord Adair Turner, Chair, Energy Transitions Commission, UK

The event also featured a talk by the Keynote Speaker Shri TV Narendran, CEO & MD, Tata Steel who emphasized that execution of De-carbonizing heavy industry needs focus on long term goals as well as short term goals. He brought out that challenges in execution would be co-related during short-term and long-term processing. Social and economic issues are crucially important while considering reduction of the carbon footprint.

Shri TV Narendran, CEO & MD, Tata Steel was the Key note Speaker of Technical Session-III: De-carbonizing heavy industry

Three Technical Sessions pertaining to **Theme-I: "Engineering challenges for de-carbonizing the Indian Economy"** were organised on October 26, 2021 which were based on the following areas:

a) Technical Session-I: Energy Transitions: Integrating RE technologies in the electricity sector
b) Technical Session-II: E-mobility solutions for the transport sector
c) Technical Session-III: De-carbonizing heavy industry



Dr Anuradda Ganesh, Chief Technical Advisor and Director, Cummins Technical Centre India (CTCI), Pune delivered lecture on Decarbonisation in transport sector

During Day-2 of the event i.e. on October 27, 2021, covering the achievements of Indian Engineering were highlighted through various Technical sessions to celebrate Azadi ka Amrit Mahotsav. Four Technical Sessions were organised which were pertaining to **Theme-II: "Achievements of Indian Engineering – Azadi ka Amrit Mahotsav"** on the following broad areas:

a) Technical Session-I: Super/Megastructures Civil Engineering
b) Technical Session-II: Amrit moments in Chemical Engineering
c) Technical Session-III: Amrit moments in Electronics/ Computer Engineering
d) Technical Session-IV: Amrit moments in Strategic Sector

The two-day Engineers Conclave ended with the Valedictory Session. Dr Shekhar C Mande, Secretary, DSIR & DG, CSIR was the Chief Guest of the Valedictory Session. The Welcome Address in the Valedictory Session was delivered by Prof Indranil Manna, President, INAE followed by the discussion summarizing the deliberations held on two days by the respective Coordinators - Shri VVR Sastry and

Shri Pradeep Chaturvedi, FNAE. The Vote of Thanks at the end of the event was delivered by Prof AB Pandit, Vice-President, INAE.

Valedictory Address by Dr Shekhar C Mande during the Valedictory Session held on October 27, 2021

National Frontiers of Engineering (NatFOE 2021)- White Paper

INAE organized 15th National Frontiers of Engineering (NatFoE) Symposium jointly with IIT Hyderabad on July 9-10, 2021 on virtual platform bringing together 50 bright young engineers to deliberate on emerging technologies in some key engineering sectors. Prof BS Murty, Director, IIT Hyderabad and Prof Sivaji Chakravorti, Vice-President, INAE were the coordinators of the event. Prof Chandrasekhar Sharma, IIT Hyderabad was the Convener of the event. About fifty young engineers discussed, deliberated and brainstormed the state-of-the-art knowledge and development, and highlighted the opportunities and challenges in the four major areas: Artificial intelligence & machine learning, advanced materials & manufacturing technologies, infrastructure & unconventional energy and rural technology & entrepreneurship. All the four themes were chosen carefully as key areas to focus towards making India self-reliant in engineering & technology. As a part of 75th years of independence celebrations of India, a special session on 'Azadi Ka Amrit Mahotsava' was also organized.

A **Report** on the 15th National Frontiers of Engineering (NatFoE) Symposium can be viewed by clicking here.

A **White Paper** based on the deliberations during the 15th National Frontiers of Engineering (NatFoE) Symposium can be viewed by clicking here.

Vigilance Awareness Week Celebrations by INAE held during October 26-November 1, 2021

The Vigilance Awareness week was observed at INAE from 26 October 2021 to 1 November 2021 at INAE. The theme was based on "Independent India @75: Self Reliance with Integrity". In order to create awareness among the employees, various activities were organized at INAE such as quiz competition etc. To highlight the importance of following ethical practices in all sphere of life, a talk was delivered by Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE wherein he highlighted that the Central Vigilance Commission has the mandate under the Central Vigilance Commission Act, 2003 to fight corruption and to ensure integrity in public administration. A buzz was also created on INAE social media platform, INAE website, notice board etc to mark the event.

CSIR-INAE Consultative Committee Meeting held on December 9, 2021

CSIR-INAE Consultative Committee had been constituted in the year 2020. The objective of Consultative Committees is to discuss and decide on areas of mutual interest of both organizations so as to align the activities undertaken by INAE with the thrust areas of national importance. A CSIR-INAE

Consultative Committee meeting was held online on December 9, 2021. During the meeting discussions were held regarding the involvement of INAE with CSIR's "Hydrogen Energy Mission Programme" which has been launched by CSIR with an aim for Hydrogen Energy Vector to play a major role for India becoming "Atmanirbhar Bharat" in the area of Clean Energy. The meeting was attended by the members of the CSIR-INAE Consultative Committee who discussed the way forward regarding the role of INAE in this mission programme.

Discussion Meeting on Study on "Housing in India - Challenges & Way Forward by the INAE Forum on Civil Infrastructure held on December 9, 2021

One of the salient activities of INAE is to include programmes on issues of technology policy and overall development for the benefit of society, such as INAE Forums and other such activities. Towards this direction, INAE Forum on Civil Infrastructure had been constituted to address the subject area of Infrastructure, to cover specifically the issues of Traffic & Transportation, Housing and Water. The main objective of the forum is to create reports from its study to recommend needed actions related to Policy Initiatives, Engineering Development/Research, Education, and so on, and suggesting the Way Forward. A report entitled, "Urban Transportation: Challenges and Way Forward" based on the study, was released last year in December 2019 during INAE Annual Convention held in Jaipur. As per the mandate of the Forum, this year a study on HOUSING was undertaken by the Forum. The study has since been completed and a report is under finalization. In order to solicit views on the report from eminent domain experts, an extended summary was developed and circulated to the experts. Based on the responses received, a Webinar was organized to seek final inputs for improving and finalising the report on "HOUSING" on December 9, 2021. Several domain experts from Government sector, Industry and Academia were invited to join the Webinar. Shri Durga Shankar Mishra, Secretary to the Government of India, Ministry of Housing and Urban Affairs (MoHUA) was the Honoured Guest Speaker during the Webinar. The Webinar was very well received by the target audience and the inputs were useful in finalizing the report.

Local Chapter Activities

INAE Kanpur Local Chapter

- **"100 seconds"; a technical video competition by INAE Kanpur Chapter**

INAE Kanpur Chapter conducted a "100 seconds" technical competition, wherein doctoral scholars submitted a summary/impact of their research through a video of maximum 100 seconds! It was held on the occasion of INAE commemorating 75 years of India's independence via "Azadi ka Amrit Mahotsav". Doctoral scholars (having completed 2.5 years in the program) described their research within a 100 seconds video! A brief report on the competition can be viewed by clicking here.

INAE Bangalore Chapter

- 6th SAMVAAD Lecture – an IIT Dharwad-INAE Bangalore Chapter Lecture Series – by Former Director and Chief Designer of LCA, Dr Kota Harinarayana, on "**Aatmanirbhar Bharat in Aviation-- From Light Combat Aircraft to Regional Transport Aircraft Development"** was held online on October 27, 2021.

- INAE Bangalore Chapter Frontiers of Engineering Webinar by Prof Navakant Bhat on **"Sensor Scaling for Intelligent Heterogeneous Systems"** was held online on October 28, 2021.

- 7th SAMVAAD Lecture – an IIT Dharwad-INAE Bangalore Chapter Lecture Series – by Prof. Anil D. Sahasrabudhe on the topic **"Empowering Students Through NEP"** was held online on November 24, 2021. **INAE Bangalore Chapter Online Workshop on "Technologies for Transformation of Indian Agriculture"**

- INAE Bangalore Chapter organized an online one-day workshop on **"Technologies for Transformation of Indian Agriculture**" on January 10, 2022 in association with the Indian Institute of Science, Bangalore, University of Agricultural Sciences, Bangalore, and ICAR-Indian Institute of Horticultural Research, Bangalore for academics, scientists, industry practitioners, entrepreneurs, agriculturists, and administrators working in agricultural technologies. The objective of the workshop was to share the experiences in modern agricultural technologies and understand implementation challenges, identify solutions, and recommend future strategies. The expected outcome is to come up with a strategy report summarising theme-wise recommendations and suggestions to policy makers in the agri-ecosystem. The Brochure of the workshop can be viewed by clicking here

- 8th SAMVAAD Lecture (an IIT Dharwad - INAE Bangalore Chapter Lecture Series) on "Floods in a Changing Climate: An Emerging Engineering Challenge" wherein lecture delivered by Prof. P.P Mujumdar, Fellow of INAE, Chairman, ICWaR; Professor, Department of Civil Engineering, Indian Institute of Science, Bangalore was held on January 28, 2021.

INAE Delhi Chapter

- The Electrical Engineering Department & School of Interdisciplinary Research, IIT Delhi in collaboration with INAE Delhi Local Chapter. Organized a webinar **on "Livin' in a Material World: Materials Driving the Data Storage Revolution"** by Dr. Siva Sivaram, President, Western Digital, USA on October 28, 2021.

INAE Mumbai Chapter

- **Webinar on "Future Mobility: E Mobility" on 9th August 2021,**

A webinar on e-mobility was organised by INAE Mumbai Chapter on August 9, 2021 in the online mode. The webinar was facilitated by INAE and hosted on its WebEx platform. Considering the multifaceted nature of the topic, the webinar was organised in the format of a panel discussion, with five panelists covering different aspects that determine and impact the transition to e-mobility in India, from sustainability aspects to aspects of technology to standards and infrastructure requirements. Each speaker spoke on a topic for about 15 minutes, and there was a Q&A session at the end. Prof A K Suresh, Co-Chair, INAE Mumbai Chapter, was the moderator.

The following were the speakers and the topics they addressed:

1. Prof KV Krishna Rao, Department of Civil Engineering, IIT Bombay, on "Sustainability considerations in mobility options"
2. Dr Rutooj Deshpande, Battery Scientist and CEO, GoVidyouth mobility Pvt Ltd., on "Battery Technologies: Challenges and Opportunities"
3. Prof Sandeep Anand, Department of Electrical Engineering, IIT Bombay, on "EV Power train: R&D Challenges and solutions"
4. Dr Sajid Mubashir, Department of Science and Technology, GoI, on "Four power classes of EV infrastructure"
5. Sri Suman Basu, Head, Energy storage systems, Mahindra EV Technical Centre, on "e-Mobility: A perspective from Industry"

Brief synopses of the presentations made by the above speakers appear below.

Sustainability considerations in mobility options (Prof KV Krishna Rao):
Sustainable transportation is about providing access to people, goods and services in an environmentally responsible, socially acceptable and economically viable manner. In this talk, in the beginning, Prof Rao

spelt out the externalities of the transport system, taking a few of the Indian cities as examples. The adverse effects of improper urbanization and motorization along with trends of vehicle ownership were presented. Subsequently, the policies prescribed through national transport policy for moving towards sustainable urban transportation were discussed. Positive impacts of implementation of mixed land use concepts and public transport enhancements were described. The role of mobility options like shared mobility, micromobility, autonomous vehicles and electric vehicles in achieving sustainability in transportation was presented. The pros and cons of increasing electric vehicle usage were presented, drawing inferences from the literature. Electric vehicles eliminate tail-pipe emissions resulting in reducing human exposure to pollution and thereby reducing adverse health impacts of transportation. However, it is to be noted, that these emissions are shifted to upstream (power plants) processes. Substantial reduction in greenhouse gases happens only when we decarbonize electric generation. The current unacceptably high share of accidents involving motorized two-wheelers was then brought into focus. The importance of encouraging e-two-wheelers for short trip lengths and for making access and egress trips to public transport was highlighted. In the end, the policy instruments for achieving sustainable transportation were summarized.

Battery technologies: Challenges and Opportunities (Dr Rutooj Deshpande):
In this talk, Dr Deshpande described the advancements in lithium-ion batteries, which are playing an instrumental role in vehicle electrification and energy storage systems throughout the world. Variety of chemistries such as LFP, NMC, NCA, LTO etc. within the lithium-ion family allow the battery design for applications ranging from high power domain to high energy domain. Nevertheless, the challenges with respect to limited energy density, limited battery life, low charging rate, safety issues etc. pose major engineering and research challenges for lithium-ion batteries for wider acceptance going forward. From the Indian perspective, in addition to technical challenges such as typical higher operating temperatures, the commercialization challenges such as limited charging station infrastructure and limited buying capacities of the potential customers add to the list of hurdles for market penetration of EVs and BESSs. Moreover, lifecycle analysis studies have demonstrated that maximum utilization in the first and the second life of batteries and thereafter appropriate recycling of batteries are critical steps to make battery usage environmentally friendly. To enable this, interconnection of fundamental research, engineering research and product development is needed. Moving beyond current lithium-ion, chemistries such as solid-state batteries, sodium ion, aluminium-air and fuel cell technologies etc. are showing signs of initial success and could play a vital role in bringing cost effective solutions.

EV Power Train: R&D Challenges & Solutions (Prof Sandeep Anand):
The adoption of EV have several benefits over ICE based vehicles such as zero tailpipe emission and low component count. Dr Anand focused on the power train of an EV with its different subsystems such as motors, power converters, thermal management unit, etc. R&D in these subsystems is essential to achieve high power density and high efficiency, leading to improved vehicle performance, increased range and reliable operation.

The presentation focused on the research challenges associated with different aspects of power train. Starting with a discussion on permanent magnet (PM) motors, and their suitability for e2w, some of the challenges associated with use of permanent magnets and their solutions were discussed. Power converters play an important role in controlling the motors. Some of the new technologies in this area, such as use of wide bandgap (WBG) devices and integrated converter architecture were discussed. Further, the presentation also covered the state of research on reliability enhancement of power converters. Some of the R&D activities being carried out at IIT Bombay in this area were described.

Four power classes of EV infrastructure in India (Dr Sajid Mubashir):
In his talk, Dr Mubashir spoke about the development of Indian standards for safety and testing of EV charging devices, AC &DC charging devices for light EV and DC fast charging devices for cars & buses

(both CAN & PLC Communication Systems). He also talked about the standards under development, for destination charging of cars (both AC & DC), High Power Charging Systems for Buses: Automated Connection Systems and Dual Gun Charging Systems, and Battery Swap System for Light EV & eBus.

E-Mobility: A perspective from Industry (Mr Suman Basu):
Mr Basu spoke about the different aspects of Li-ion battery pack design, a key enabler of e-mobility, and also in general about the broader perceptions in industry on the possibilities on e-mobility. Electric vehicle revolution has finally reached the shores of India. Electric vehicle has been made possible due to the advent of high energy density, reversible, high efficiency electrical energy storage devices — in other words, Li-ion cells. Therefore, Li-ion battery pack design is the single most important aspect of the electric vehicle design. Battery pack design is an interdisciplinary subject involving packaging, structural, thermal, electrical and electrochemical aspects. Enough energy needs to be safely packaged and thermally managed within a given volume with weight constraint. Behaviour of the cell must be well understood and controlled to achieve best performance and/or life. A point to remember here is that there is no "perfect cell". A cell will be chosen based on energy density, power density, life expectancy, safety and cost. It is highly usage specific and can often have multiple solutions.
The most crucial part of the battery pack design is the battery management algorithms including the cells state estimation. A robust and efficient battery management system can improve the performance and life expectancy of a battery pack significantly. There is a lot of scope for using advanced techniques like AI, cloud computing, prognostics to this end. For India, it can be an opportunity to differentiate itself from others and develop a niche product.

- INAE Mumbai Chapter organized a Webinar on **"Decarbonisation of Cement, Steel & Power sector"** on Friday, 22nd October 2021 through WebEx Platform to commemorate celebration of India's 75th Year of Independence (Azadi ka Amrit Mahotsav). Dr RB Grover, FNAE, Co-convenor, INAE Mumbai Chapter, Emeritus Professor, Homi Bhabha National Institute, Mumbai was the Moderator of the said Webinar. Mr Ulhas Parlikar who retired as : Director, Geocycle Business & Dy. Head, Geocycle India presented the webinar. A report on the webinar is given below.

Decarbonisation of Cement, Steel & Power sector
Ulhas Parlikar, Presentation made on 22nd October 2021

Abstract
Release of a large quantity of CO2 by the industry sectors into the environment is the reason for the ongoing climate change. The three industry sectors that contribute maximum to the CO2 emissions are Power, Steel and Cement. These industries are preparing to control the emissions so as to ensure <1.5% Deg. C increase in the ambient temperature compared to the pre-industry period. Some of them are also trying to achieve net zero CO2 status in a defined time line. The major levers available for them to achieve the same are following.

1. Improve the resource efficiency in their operations.
2. Reduce the use of fossil fuels and raw materials that contribute to CO2 emissions.
3. Replace the fossil resources with renewable ones such as green Hydrogen
4. Replace the fossil fuel-based energy with renewable energy such as Solar, Wind, geothermal, tidal, etc.
5. Convert CO2 into Algae and use it as fuel.
6. Conversion of CO2 into value added chemicals.
7. Carbon Capture & Sequestration.
8. Utilize waste materials as resources in the manufacturing process. (Co-processing)

Co-processing is based on the principles of industrial ecology and stands for the usage/disposal of waste material in Resource Intensive Industries (RII). Co-processing option facilitates circular economy and offers a large opportunity for these industries to reduce their CO2 emissions. Cement industry is a leader in the co-processing initiative and utilizes large quantities of wastes derived out of industrial, municipal and agricultural sectors as Alternative Fuels and Raw materials (AFRs) in cement manufacture. There are a few cement plants globally that are able to replace the fossil fuels to an extent of >90% and also a few who are able to replace raw materials up to >60%. The technology of co-processing in cement industry is a highly developed science and it is well recognized by most of the stakeholders. Based on large number of demonstration trials, it has been approved as an option for management of Hazardous and difficult to treat waste by the international conventions such as Basel Convention and Stockholm convention. It has also been recognized as a preferred option for waste management in most of the developed countries and also some of the developing countries. To utilize wastes as resources they need to be processed through a technology called pre-processing and since these resources get involved into chemical reactions in cement manufacture, they need to be pass through a strict quality control assessment. Cement industry is able to demonstrate that it is feasible to reduce the GHG emissions by more than 70% by use of wastes in its manufacturing process.

Apart from cement, co-processing technology is gaining focus of the Steel and Power sectors as well. A large variety of waste streams from industrial, municipal and agricultural sector can be utilized in these sectors. There are already some examples globally in steel and power sectors where the fossil fuel is fully replaced with wastes and hence there is opportunity for the entire industry segment representing steel and power to pursue higher level of waste utilization in their operations.
The Solid Waste Management Rules 2016 of the Government of India have already mandated 5% replacement of fossil fuels in such industries with Refuse Derived Fuel (RDF) from municipal sources. Higher level of RDF usage is also feasible in these industries. There is also feasibility of using other waste materials derived out of industrial & agricultural sectors. Currently, the stakeholder acceptance of this technology in these industry sectors is rather low. Hence, both these industries need to improve the stakeholder confidence by implementing demonstration trials of utilizing different kinds of wastes in their operations as has been done by the cement industry.

INAE Bhubaneswar Chapter

- First Inaugural Lecture of the Distinguished Lecture Series Organized by INAE Bhubaneswar Chapter, SOA University and IMMT Bhubaneswar was held online on 7th December, 2021 wherein Lecture on "Science-Engineering-Technology: Synergy for Sustainable Growth" was delivered by Professor Indranil Manna, President, INAE and Vice Chancellor, BIT, Mesra.

- The Second Lecture of the Distinguished Lecture Series Organized by INAE Bhubaneswar Chapter, SOA University and IMMT Bhubaneswar on "Democratized Diagnostic Technologies towards Affordable Healthcare for the Underserved" was delivered online by Dr. Suman Chakraborty, Institute Chair Professor & Sir J C Bose National Fellow; Dean, Sponsored Research and Industrial Consultancy Professor, Department of Mechanical Engineering, Indian Institute of Technology Kharagpur on 7th January 2022.

INAE Hyderabad Chapter

Report on INAE lecture on "Role of Artificial Intelligence in Missile Applications"

Dr BHVSN Murthy, Distinguished Scientist, DG(MSS) delivered a lecture on 'Role of artificial intelligence in Missile applications' on 9th Dec 2021 on INAE platform via online mode. The event began with address by Dr Dasharath Ram, Distinguished scientist, Director, DRDL & chairman, Hyderabad chapter followed by introduction of the speaker by Dr Jaiteerth R Joshi, Scientist G, DRDL.

The lecture focussed on evolving hybrid threats, role of AI in military operations, advantages of Inclusion of AI in defence systems, application of AI in missile systems and computer vision, use of AI in real time decision making and design of Decision Making Missiles, strategies for missile swarms and AI assisted missile targeting. The use of AI in surveillance, Geo-Spatial analysis, identification of hidden nuclear missiles, homeland security, cyber security and logistics were also discussed in length. The speaker also presented interesting AI case studies in Indian Defence, Israel Defence, European Defence, and US defence. Towards the end of lecture, the speaker discussed 'AI Roadmap for RCI and Indian Defence' which included ongoing research efforts for design and development of AI based defence systems in DRDO.

In questionnaire session, the participants discussed on few pertinent aspects of AI such as implementation of QA/QT for AI Systems, extending the usability for civilian applications and guidelines for patenting of AI systems. The Chairman thanked the distinguished speaker for his outstanding lecture, participants and INAE team for successful event.

Report on INAE lecture on "Material for Defence: Challenges and Opportunities"

Dr. Samir V Kamat, Distinguished Scientist, DG (Naval Systems & Materials) delivered a lecture on 'Material for Defence: Challenges and Opportunities' on 17th January 2022 on INAE platform via online mode. The event began with address by Dr Dasharath Ram, Distinguished scientist, Director, DRDL & chairman, Hyderabad chapter followed by introduction of the speaker by Dr Jaiteerth R Joshi, Scientist G, DRDL. The Fellows of INAE, scientists from various organisations such as DRDL, DMRL etc participated during the event.

Development of new Defence Materials usually face three specific challenges namely low volume, stringent qualifications and very long development time ranging from 5 to 20 years. The speaker discussed in length on above challenges and presented 4 indigenous case studies of material developments (Naval Steel, Titanium, Nickel cobalt and DMR-1700). In order to expedite the development of new materials, he proposed innovative strategies such as Integrated computational material engineering, Material Genome Initiative and Material development Continuum.

In questionnaire session, Shri Sreenivas R raised queries on different standards for same material and suggested for mapping of materials and same were answered by the speaker. The Chairman thanked the distinguished speaker for his outstanding lecture, participants and INAE team for successful event.

International Affairs

CAETS 2021 Annual Meetings and Technical Discussion on 'The Future of Energy'

INAE is a Member-Academy of the International Council of Academies of Engineering and Technological Sciences (CAETS) and participates in its programmes/convocations of global concern for benefits at national/international levels. Last year, the CAETS 2021 Annual Meetings and Technical Discussion on 'The Future of Energy' was hosted online by Academia Nacional de Ingenieria (ANI), Argentina (Argentina's Academy of Engineering) on September 21-23, 2021 at Buenos Aires. INAE delegation participated in various Technical Sessions. INAE nominated Prof. Rangan Banerjee**,** Department of Energy Science and Engineering, IIT Bombay, Mumbai, India as a Panellist during Technical Session I on Energy Demand / New Trends held online on September 21, 2021 and Mr. N Saibaba, Former Raja Ramanna Fellow, Former Chairman & Chief Executive, NFC and Advisor to Chairman AEC & Secretary DAE, India during Technical Session II on "The Future of Nuclear Energy" held online on September 21, 2021. Mr Pradeep Chaturvedi participated in the meetings of CAETS Sustainable Development Goals (SDG) Group. Prof SS Chakraborty participated in the Working Group

on Cement industry. Mr Pradeep Chaturvedi and Prof Bibek Bandyopadhyay also represented INAE on CAETS Energy Working Group on Buildings.

Forthcoming Events

Online Expo of Innovations by Start-ups in India

Indian National Academy of Engineering (INAE) is organizing an **"Online Expo of Innovations by Start-ups in India"** in association with NIT Calicut on **April 1-3, 2022** to commemorate "Azadi ka Amrit Mahotsav" initiative of Govt of India. The subject event is being supported by National Innovation Foundation; Startup Incubation and Innovation Centre, IIT Kanpur; Maharashtra Innovation Society; Kerala Start up mission and Centre for Innovation Incubation and Entrepreneurship (CIIE.CO). Prof. Sivaji Chakravorti, Vice-President, INAE is leading the subject event on behalf of INAE.

The Brochure of the subject event has been e-inaugurated on 7th February 2022 at a grand function. This news has been published in the national newspaper "The Hindu" which can be viewed by clicking at the link given below:

https://www.thehindu.com/news/cities/kozhikode/nit-c-inae-join-hands-for-online-start-up-expo/article38404081.ece

The highlights of the said event are as under:

a. The event will be an "Online Exposition of Innovations by Start-ups in India" wherein any entrepreneur/ team willing to showcase their ideas /projects has to present the innovation in video format.
b. Themes of the Online Expo are:
   - Clean Mobility
   - Waste to Wealth
   - Agriculture Technology
   - Skilling and Livelihood
   - Digital Healthcare Technologies
c. Prizes for the winners of each focal sector of the exposition would be given:
   - Rs.50,000/- for winners
   - Rs.25,000/- for runners up
d. The last date of receiving applications is **7th March 2022** and shortlisting of videos is **21st March 2022 which has now been extended to March 20, 2022 and March 25, 2022 respectively.**

For further details on the subject Expo, you may kindly go through the event Brochure which can be viewed by Clicking here.

Academia Industry Interaction

AICTE-INAE Distinguished Visiting Professorship Scheme

Industry-academia interactions over technological changes have become essential in recent times so that relevant knowledge that would be sustainable in the changing conditions can be imparted to the students in the engineering institutions. While industries could gain by using the academia's knowledge base to improve the industry's cost, quality and global competitive dimensions; thereby reducing dependence on foreign know-how and expenditure on internal R&D, academics benefit by seeing their knowledge and expertise being fruitfully utilized practically and by strengthening of curricula of educational programs being offered at engineering colleges/institutions. INAE together with All India Council for Technical Education (AICTE) launched "AICTE-INAE Distinguished Visiting Professorship Scheme" in 1999. Under this scheme, Industry experts are encouraged to give a few lectures in engineering institutions. This scheme has become popular among industry experts as well as engineering colleges.

Brief details pertaining to recent visits of industry experts under this scheme are given below.

Dr. Debabrata Das, FNAE Retd. Prof. IIT, Kharagpur, Renewable Energy Chair Professor, Department of Biotechnology, Professor in Charge, P K Sinha Centre for Bioenergy IIT, Kharagpur	SRM Institute of Science and Technology, Kancheepuram, Tamilnadu Sep 13-15, 2021 Sep 20-22, 2021	Delivered lectures on "Advanced biofuel production processes using renewable resources", "Fundamentals and technology advances of biohydrogen production processes" and "Biohythane: Fuel for the future". As per the feedback receive from the engineering college, the lectures covered a wide spectrum of biofuel which was beneficial for students. Delivered lectures on "Kinetics of Biohydrogen production", "Thermodynamic and Kinetics of Biomethanation process" and "Effect of physico-chemical parameters on the biohydrogen production". As per the feedback received from the engineering college, the lectures covered a wide spectrum ranging from fundamental to state-of-the-art technological advances in biohydrogen production and bio- fuel which was beneficial for students and faculty members.
Dr. Prasanta Kumar Panda Chief Scientist and Deputy Head, CSIR-National Aerospace Laboratories	RV College of Engineering, Coimbatore Jun 14-16, 2021	Delivered lectures on "Introduction and Classification of materials", "Crystal structures and Defects" and "Sintering Grain Growth and Microstructures". As per the feedback received from the college, the DVP has guided MTech with their project, a PhD student has enrolled under his supervision and he has helped to revise and modify the syllabus on Advanced Material.
Prof. Rajendra Prasad Chhabra, FNAE Retired Professor, IIT Kanpur, Mentor and	Shaheed Bhagat Singh State Technical Campus, Punjab Sep 14 & 28, 2021	Delivered lectures on "Making of an Engineer- Part I" and "Making of an Engineer- Part II". As per the feedback received from the College Coordinator, the DVP also had discussion on introducing possibilities of electives on soft matter, energy and

Visiting Professor, IIT Ropar	 Oct 12 & 26, 2021	environment. The College has also arranged for a next meeting where MTech Curriculum will be discussed. Delivered lectures on "How to make most of the College Experience to become a Complete Professional" and "Making of an Engineer- Part III".
Dr. SL Mannan, FNAE Former Outstanding Scientist and Director Metallurgy and Materials Group, Indira Gandhi Centre for Atomic Research, Kalpakkam	Government College of Engineering, Salem Sep 23-25, 2021	Delivered lectures "Plastic Deformation and Dislocation Theory-Part I", "Plastic Deformation and Dislocation Theory-Part II" and "Dislocation Interactions and Strain Hardening". As per the feedback received from the engineering Institute, the interactions were very beneficial for students and faculty members. They have expressed more interactive sessions in future in the thrust areas.
Dr. Chandrashekhar V. Rode, FNAE Formerly Chief Scientist, CSIR-National Chemical Laboratory, Pune, currently CSIR-Emeritus Scientist	Department of Technology, Shivaji University, Kolhapur Sep 28-30,2021 Oct 8, 2021	Delivered lectures on "Catalysis", "Catalytic ways for Green Processes", "Reactors and Kinetics" and "How to write Research Proposals". Delivered lecture on " Career Opportunities".
Prof. V Radhakrishnan, FNAE Professor, Department of Mechanical Engineering, IIT Madras & Emeritus Professor of Indian Institute of Space Science and Technology	Indian Institute of Space Science and Technology, Valiamala, Kerala Oct 26-28, 2021	Delivered lectures on "Engineering' Academic Research", "Innovative Research" and "Art & Craft of publishing the Research Findings". As per the feedback received from the Engineering Institute, the lectures were useful for students planning or doing research. The lecture on Innovative Research gave insights into the need for bringing in innovative ideas in academic research.
Mr. Ajay Narayan Deshpande, FNAE Ex CMD & Director (Technical), Engineers India Limited	Manipal University, Jaipur Aug 21, 2021 Oct 16, 2021	Delivered lectures on "Refinery Configuration & Technology Developments-Past, Present and Future Scenario". As per the feedback received from the college, the DVP also guided projects on different topics. The scheme is highly beneficial for both students and faculty members. Delivered lectures on "Optimising design for Refineries to meet changing Environmental stipulations on fuel quality". As per the feedback received from the faculty coordinator, the DVP also guided projects on seven different topics related to the subject and guided College Authority with syllabus for the new graduate program on Petroleum refining and Petrochemicals.

Dr. K. C. Vora Sr. Deputy Director & Head, ARAI	G H Raisoni Institute of Engineering and Technology, Pune Sep 27, Oct 4, 6, 2021	Delivered lectures on "EV Battery Management System", "EV Motors and Controllers" and "Infrastructure of EV Charging Station". As per the feedback received from engineering college, the DVP has guided student on projects and had discussion on revision of syllabus. The scheme is excellent for interaction with industry specialist which help enhancing knowledge on advanced technology used in industry and generate new industry contacts.
Dr. N. S. Raman Former Deputy Director & Head Environmental Audit (NEERI)	DY Patil College of Engineering, Pune Sep 28-30,2021	Delivered lectures on "Need of Environmental Impact assessment for sustainable Development", "Water Footprint" and "Methods of EIA". As per the feedback received from the faculty coordinator, the lectures have been highly beneficial for students and faculty members. The lectures motivated the UG and PG student in their thesis. The DVP also helped in identifying projects on waste treatment using phytoremediation.
Dr. Satyanarayana Bheesette, Scientific Officer (H), TIFR, Mumbai, Coordinator, India-based Neutrino Observatory (INO) Project Visiting Professor, Dept. of Applied Science, American College, Madurai	Symbiosis Institute of Technology, Mulshi Oct 25,27-28, 2021	Delivered lectures on Sensors, Circuits and Actuators"," Signal processing and Data acquisition for science experiments", "Recent trends in Smart Sensor instrumentation and signal processing" and "Sensors and Signal processing for Medical and IoT Applications". As per the feedback received from the engineering college, the real-life examples discussed by DVP had helped students to relate text book study to real time problems. The lectures were application based.
Dr. Chitra Rajagopal, Distinguished Scientist and Director General, System Analysis and Modelling (SAM), DRDO, Delhi	Dept of Chemical Engineering, Alagappa College of Technology Campus, Anna University, Chennai Oct 27, 29, 2021	Delivered lectures on "Safety case study", "Probabilistic risk Assessment", "Risk Acceptance Criteria for process plants" and "Hazard Management". The feedback received from College indicates that lectures were accompanied with videos for better understanding. The lectures were interactive and beneficial for students.
Dr. SL Mannan, FNAE Former Outstanding Scientist and Director Metallurgy and Materials Group, Indira Gandhi Centre for Atomic Research, Kalpakkam	Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, Chennai Oct 29-31, 2021	Deformation and Dislocation Theory-Part I", "Plastic Deformation and Dislocation Theory-Part II" and " Strengthening Mechanisms". As per the feedback report received from engineering College, the lectures of the DVP have been beneficial for students and they look forward to more lectures. The Dean -Academics was very happy and appreciated the scheme.

Dr. Ram Kumar Singh, FNAE DAE Raja Ramanna Fellow & Senior Professor Homi Bhabha National Institute, Reactor Design and Development	Graphic Era (Deemed to be University), Clement Town, Dehradun Oct 24-26, 2021	Delivered lectures on "Nuclear Containment Structural Safety and Performance Evaluation", "Hydrogen Blast Load Characterization and Safety Assessment of Structures" and "Nuclear Containment Aircraft Impact and Fire Load Assessment". As per the feedback received from the college, the DVP also helped in identifying projects. The scheme is very helpful for making the students prepared for industry.
Dr. Debabrata Das, FNAE Retd. Prof. IIT, Kharagpur, Renewable Energy Chair Professor, Department of Biotechnology, Professor in Charge, P K Sinha Centre for Bioenergy IIT, Kharagpur	Heritage Institute of Technology, Anandpur, Kolkata Nov 10-12, 2021 Nov 19-20, 29, 2021	Delivered lectures on "Zero Carbon fuel", "Algal Biorefinery: an integrated Approach Biohythane: Fuel for the future" and "Paper based microbial fuel cell". As per the feedback received from the engineering institute, the association with the DVP has been beneficial both for the students and the faculty members. Delivered lectures on "Stoichiometry of Bioprocesses", "Material and energy analysis of bioprocesses" and " sterility of the biochemical industries". As per the feedback received from the engineering college, the interactions have been highly beneficial for research activities of the department. College is looking forward to more such interactions.
Prof. S Sreenivasa Murthy, FNAE Formerly Professor, IIT Delhi	Dayananda Sagar College of Engineering, Bengaluru Nov 20, 26 & Dec 4, 2021	Delivered lectures on "Discussion on Project proposals and Research activities in the department", "Research Methodology, Professional Ethics and Value education" and "History of Machines and its fundamentals in Industrial Applications".
Dr. Raghavan Gopalan, FNAE Regional Director, International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI), Chennai	Dr. Raghavan Gopalan, FNAE Sep 10, 2021 Nov 29, 2021	Delivered Lectures on "Critical Materials Technology for EV and Automotive Applications". As per the feedback received from engineering college, Dr. Gopalan discussed project on Alternative Energy and systems with UG students and had also suggested a course on Energy Storage Materials like Li- ion battery, magnetic materials etc. The content of the lecture and his expertise has been beneficial for students and faculty members of the department. Delivered lectures on "Introduction to Exotic materials in Materials Science and Engineering". As per the feedback received from the engineering college, the interaction has been very inspiring for students and faculty members.

Dr. Bharat Bhanudas Kale Scientist G/Director General (A)/ Director (A), Centre for Materials for Electronics Technology (C-MET), Pune	Symbiosis Institute of Technology, Mulshi Oct 13-14, 2021 Nov 25-26, 2021	Delivered lectures on "Energy generation materials" and "Energy generation devices fabrication and current status". As per the feedback received from college, the DVP guided PhD thesis of a Senior research Fellow and suggested revision in curriculum. Delivered lectures on "Best Practices in Research, Ethics in research publications" and conducted demonstration of "Research facilities available at C-Met". As per the feedback received from engineering colleges, the DVP guided research fellows on their PhD work and had discussion on revision of syllabus of courses like Physics, Nanotechnology and Smart Materials.
Prof. Ganapati Panda, FNAE Former Deputy Director & Prof. School of Electrical Sciences, IIT Bhubaneswar, Research Advisor for CV Raman College of Engineering, Bhubaneswar, Odisha	BVRIT Hyderabad college of Engineering for Women, Bachupally, Hyderabad Dec 6-8, 2021	Delivered lectures on "K-Means, ANN algorithms", "Decision tree algorithms" and "Convolution Neural Networks". As per the feedback given by faculty coordinator, the interactions with DVP has helped faculty to take up industrial challenges for writing proposals. The DVP has guided Students on their Projects. The college would like more such interactions.
Dr. Debi Prasad Das Senior Scientist, CSIR –Institute of Minerals and Materials Technology	Silicon Institute of Technology, Bhubaneswar Sep 4 & 6, 2021	Delivered lectures on "How easy it is to write a Project Proposal" and "Principle to Prototype". As per the feedback received from the engineering college, the DVP has contributed in both academics and research capabilities of the college. He has guided projects and guided faculty members on LoRa based communication system for data transfer. He has helped to identify projects and is part of a research study identified as a collaborative joint venture with SIT & CSIR-IMMT.
Dr. G. Janakiram General Manager (Technical Services), Eurotex Industries & Exports Ltd, Kolhapur	DKTE Society's Textile &Engineering Institute, Ichalkaranji Oct 20, 2021	Delivered lectures on "Developments in Draw Frame" and "Maintenance of Draw Frame and Draw Frame Performance Assessment". As per the feedback from faculty coordinator the lectures by DVP were highly beneficial for students specially from research perspective and they could finalize their projects.
Mr. S. Krishna Kumar	RMK Engineering College, Kavaraipettai, Tamil Nadu	Delivered lectures on "Product Life Cycle Management- automotive Industry", "Lucas TVS Ltd- Engineering setup, New Product development

Former Senior Vice President (Retired), Lucas TVS Ltd, Chennai	Oct 28-29, 2021 & Nov 1, 2021	process, JIT manufacturing system, Product testing" and "Virtual visit to MEL Systems and services Ltd.- Background, Industrial automation solutions, product special manufacturing process involving tracking and traceability using IoT, AI and ML solutions". As per the feedback received from the college, the scheme assists students in gaining clarity in career selection and faculty members in imparting specific industry-oriented knowledge. The DVP helped in identifying projects on e-mobility and design of experiments, guided various ongoing projects and suggested on modification of course curriculum.
Dr. SL Mannan, FNAE Former Outstanding Scientist and Director Metallurgy and Materials Group, Indira Gandhi Centre for Atomic Research, Kalpakkam	Government College of Engineering, Salem Nov 15-17, 2021	Delivered lectures on "Grain Boundary strengthening and Solid solution strengthening". "Strain ageing, Precipitation, Dispersion strengthening and Design of Ni base alloys" and "Fatigue- S-N Curves, Stress controlled fatigue, LCF and HCF, Mean stress, Cumulative damage". As per the feedback received from the college, the lectures are on current topic of research and both students and faculty members participated enthusiastically during the sessions. He has also helped guiding student projects and suggesting modification of course curriculum.
	Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, Chennai Nov 20-22, 2021	Delivered lectures on "Solid solution strengthening, Precipitation Strengthening, Dispersion Strengthening and design of Ni base superalloys", "Fatigue (S-N curves, Stress-controlled Fatigue, LCF and HCF, Mean Stress, Cumulative Damage)" and "Fatigue (Material behaviour, Surface treatments, Notch effects)". As per the feedback received from the engineering college, the lectures are very helpful, and the college authorities would like to have more such lectures.
Mr. N Venkatesh, FNAE, Sr. Vice President, Advanced Technologies, Redpine Signals Inc, Hyderabad	VNR Vignana Jyothi Institute of Engineering and Technology Nov 16-17, 2021 Nov 29-30, 2021	Delivered lectures on "Insight into IoT" and “Wireless Technologies in the IoT”. According to the feedback received from the faculty coordinator, the lectures on IoT have been beneficial for students in developing projects. The DVP also guided students on how to prepare for core jobs in technology field. Delivered lectures on "Edge Intelligence" and "Battery life enhancement of IoT Devices". As per the feedback received from the engineering college, the lectures from DVP have helped both students and faculty members understand the industry perspective of technologies.

Prof. S Sreenivasa Murthy, FNAE Formerly Professor, IIT Delhi	BMS college of Engineering, Bengaluru Nov 17-19, 2021	Delivered lectures on "Research Proposal and Funding", "Thrust areas on solar, wind, hybrid system" and " Inputs related to funding agencies and effective writing".
Dr. Vishwas R. Udpikar Managing Director, SCI-COM Software India Pvt. Ltd.	Rajarambapu Institute of Technology, Sangli Nov 18, 2021	Delivered lectures on "Signal Processing applications and Radar", "Opportunities in industries for students" and "Recent trends and topics in image processing and signal processing". As per the feedback from the college, the scheme is very helpful as institute is situated far from metro city. He has suggested modification in course curriculum and has also proposed projects like SODAR, acoustic noise cancellation and lane detection using image processing in open CV for autonomous vehicles.
Dr. Satyanarayana Bheesette, Scientific Officer (H), TIFR, Mumbai, Coordinator, India-based Neutrino Observatory (INO) Project and Visiting Professor, Dept. of Applied Science, American College, Madurai	Symbiosis Institute of Technology, Mulshi Nov 27, 2021	Delivered lectures on "The interplay between Science, Technology, Engineering & Mathematics" and "Engineering Physics: Fundamentals and modern Applications". As per the feedback received from the engineering college, the lectures of the DVP helped students to establish connection between textbook knowledge and real time applications. The scheme is helpful to develop problem-solving approach and research among students.
Prof. Ganapati Panda, FNAE Former Deputy Director & Prof. School of Electrical Sciences, IIT Bhubaneswar, Research Advisor for CV Raman College of Engineering, Bhubaneswar, Odisha	Raghu Institute of Technology, Vishakhapatnam Dec 1-3, 2021	Delivered lectures on "Introduction to Intelligent Computing", "K-means approach to classification with examples", "Native Bayes algorithm and its application", "Introduction to Machine Learning Techniques", "Decision Tree Technique", "Random Forest Technique and its applications", "Introduction to Neural Networks", "Concepts of Convolutional Neural Networks", "Artificial Neural Networks", "Recurrent NN" and " Research Paper writing and Proposal preparation standards". as per the feedback received from the engineering college, the DVP guided several projects and suggested inclusion of advanced topics in syllabus. The lectures were extremely beneficial for both students and faculty members. More such visits are needed to further improve R&D culture of the institute.
Dr. Sreekumar Thaliyil Veedu	DKTE Society's Textile & Engineering Institute, Ichalkaranji	Delivered lectures on "Introduction to Synthetic Fibre Manufacturing- Part I, II, III" and "Advances in in High Performance Fibres". As per the

Senior Consultant, Reliance Industries Ltd. (RIL)	Dec 3-4, 2021	feedback received from the faculty coordinator, the DVP guided five projects and the topics shared in lectures are helpful for students to prepare them for practical application in industry.
Dr. Raja Manuri Venkata Gopala Krishna Rao, FNAE Scientist 'G', Founder/Head-FRP Dvn-NAL-CSIR(Rtd)	East Point College of Engineering & Technology, Bangalore Dec 21-23, 2021 Dec 27-29, 2021	Delivered lectures on "Introduction to Polymer Matrix Composites', "PMC -constituents (fibre, matrices & functional roles)" and "Structure-vs-Property Relationships in PMC". As per the feedback received from the engineering college the lectures dealt in depth with the subject of PMC which were highly beneficial for students. Delivered lectures on "Processing of Fabrication Technologies", "Testing & Characterization of PMCs & Design allowables for Composites" and "Basic introduction to Nano Science and Nano Technologies". As per the feedback received from faculty coordinator of the engineering college, the lectures were insightful, comprehensive and highly beneficial for students and faculty members.

Important Meetings held during August/ September 2021

- Apex Committee Meeting held on October 5, 2021 over WebEx.
- Meeting of the Task Force on proposed Compendium on “Landmark Achievements in Engg and Technology in Independent India" held on October 4, 2021 over WebEx.
- Annual Convention Organizing Committee (ACOC) meeting for INAE Online Annual Convention 2021 held on October 19, 2021 over WebEx.
- Meeting of the Editorial Committee on Compendium on Women Engineers of India since Independence on October 20, 2021 over WebEx.
- Meeting of Search Cum Selection Expert Committee (SSEC) for Abdul Kalam Technology Innovation National Fellowship held on October 22, 2021 over WebEx.
- Meeting of Task Force on Compendium on "Landmark Achievements in Engineering and Technology in Independent India held on October 23, 2021 over WebEx.
- Meeting of the Editorial Committee on Compendium on Women Engineers of India since Independence held on October 29, 2021 over WebEx.
- Special General Meeting of Fellows 2021 held on November 1, 2021 over WebEx.
- Annual Convention Organizing Committee Meeting with Qualified Vendors held on November 2, 2021 over WebEx.
- Editorial Committee for publication of Compendium on Women Engineers of India since Independence held on 11th November 2021 over WebEx.

- 36th Steering Committee Meeting held on November 12, 2021 over WebEx.
- Meeting of the Task Force on proposed Compendium on “Landmark Achievements in Engg and Technology in Independent India" held on November 13, 2021 over WebEx.
- 32nd Finance Committee Meeting held on November 16, 2021 over WebEx.
- Meeting of the INAE Forum on Civil Infrastructure (HOUSING) held on November 16, 2021 over WebEx.
- Meeting for pre-recording of INAE Annual Convention 2021 held on November 18-19, 2021 at India International Center, New Delhi.
- Meeting of the Search-cum-Selection Committee for recommending revised composition of Governing Council held on November 24, 2021 over WebEx.
- 36th Apex Committee Meeting held on November 30, 2021 over WebEx.
- Task Force Meeting for Landmark Compendium of the Task Force on proposed Compendium on “Landmark Achievements in Engineering and Technology in Independent India" held on December 3, 2021 in hybrid mode.
- 141st Governing Council Meeting held on December 7, 2021 over WebEx.
- CSIR-INAE Consultative Committee on Clean Hydrogen held on December 9, 2021.
- Discussion Meeting for Study on “HOUSING IN INDIA - Challenges & Way Forward by the INAE Forum on Civil Infrastructure" on December 9, 2021.
- Annual General Meeting of Fellows (Part B - Session 2) on December 17, 2021 over WebEx.
- Eighth Meeting of the Task Force on proposed Compendium on "Landmark Achievements in Engineering and Technology in Independent India" held on December 23, 2021 over WebEx.
- Meeting of the INAE Forum on Civil Infrastructure (HOUSING) held on December 28, 2021 over WebEx.
- Meetings of the INAE Search Committee for Gender Parity (Group 1: Mechanical and Group 2: Electrical) held on 3rd and 4th January 2022 over Webex.
- Meeting of the Editorial Committee for Publication of Compendium on Women Engineers of India since Independence held on January 18, 2022 over WebEx
- Meeting of the INAE Forum on Civil Infrastructure (HOUSING) held on 18 January 2022 over WebEx
- Meetings of the INAE Search Committee for Gender Parity (Group 1: Mechanical and Group 2: Electrical) held on 20th and 21st January 2022 over WebEx
- AICTE-INAE Consultative Committee Meeting on January 25, 2022 over Webex.

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International/National Conferences/Seminars being Organized By IITs/other Institutions

Artificial Intelligence Trends and Pattern Recognition Conference - online and in-person, being held on 10th to 12th March 2022 at Hyderabad, Telangana.
https://conferencealerts.com/show-event?id=235529

2nd International Conference on ubiquitous computing and intelligent information systems [ICUIS 2022] - online and in-person, being held on 10th to 11th March 2022 at Erode, Tamil Nadu
https://conferencealerts.com/show-event?id=236591

IEEE 1st International Conference on Artificial Intelligence Trends and Pattern Recognition - online and in-person being held on 10th to 12th March 2022 at Hyderabad, TELANGANA
https://conferencealerts.com/show-event?id=238407

2022 Eighth International Virtual Conference on Biosignals, Images, and Instrumentation (ICBSII) Conference, online being held on 16th to 18th March 2022 at Chennai.
https://conferencealerts.com/show-event?id=240638

Note: Due to Lockdowns imposed by Government in view of Covid-19, schedule of these conferences may be rechecked.

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Padma Awards 2022

Padma Awards - one of the highest civilian Awards of the country, are conferred in three categories, namely, Padma Vibhushan, Padma Bhushan and Padma Shri. The following INAE Fellows/Foreign Fellows were conferred Padma Awards 2022 by the President of India as per details given below.

Padma Bhushan:

- Mr N Chandrasekaran, FNAE, Chairman, Tata Sons Private Limited, Mumbai
- Mr Sundar Pichai, FNAE, CEO, Google and Alphabet Inc., USA

Padma Shri:

- Prof Sanghamitra Bandyopadhyay, FNAE, Director, Indian Statistical Institute, Kolkata.

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Honours and Awards

Felicitation of Dr RK Bhandari, FNAE by Hon'ble Prime Minister of India with Subhash Chandra Bose Aapda Prabandhan Puraskar 2021

Dr RK Bhandari, FNAE, Formerly Director, Central Building Research Institute, Roorkee; Programme Director, UN-HABITAT, Nairobi; Formerly Chairman, Centre for Disaster Mitigation and Management, VIT, Vellore and former Chairman, INAE Forum on Engineering Interventions for Disaster Mitigation was conferred with Subhash Chandra Bose Aapda Prabandhan Puraskar 2021 by esteemed Hon'ble Prime Minister of India Shri Narendra Modi Ji on January 23, 2022, the birthday of Late Shri Subhash Chandra Bose, to recognize and honour his invaluable contribution and selfless service in the field of Disaster Management in India.

Dr RK Bhandari receiving the Subhash Chandra Bose Aapda Prabandhan Puraskar 2021 from Hon'ble Prime Minister of India.

The Award Booklet can be viewed by clicking here

In his interview to the National Disaster Management Authority, Dr RK Bhandari expressed his debt of gratitude to INAE with whom he has had a long association and has also been the Chairman of the INAE Forum on Engineering Interventions for Disaster Mitigation.

The Video Interview can be viewed at the link https://www.youtube.com/watch?v=8VuCIneyQiA

1	Dr Sanak Mishra, FNAE, former President, INAE; 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; President, Indian Institute of Metals had been recently interviewed by the Department of Materials Science & Engineering (MatSE) at the University of Illinois at Urbana-Champaign (UIUC) who posted on its website a Legendary Alumni Q&A interview with him which can be viewed at the link given below and a copy may also be viewed by clicking here **https://matse.illinois.edu/news/legendary-alumni-q-and-a-with-sanak-mishra**

2	Professor Chennupati Jagadish, FNAE, Editor-in-Chief, Applied Physics Reviews; Distinguished Professor, Department of Electronic Materials Engineering, Research School of Physics, The Australian National University, Canberra, Australia was elected as the next President of Australia's premier science organisation, the Australian Academy of Science. He is the first Australian of Indian heritage to take on the role. Further details are given in link below. https://www.canberratimes.com.au/story/7523642/nanotechnology-pioneer-to-take-on-australian-academy-of-science-presidency/?src=rss
3	Prof. Prem Krishna, FNAE, Formerly Professor & Head of Civil Engineering Department, IIT Roorkee; Founder President of Indian Society of Wind Engineering (ISWE) and former President IAWE has been conferred the International Association for Wind Engineering (IAWE) Presidential Award for career long contributions to wind engineering with particular reference to low rise structures, code development and leadership to the ISWE and IAWE, during an award ceremony held on October 28, 2021 presided by Prof Shuyang Cao, Secretary General, IAWE. A flier for the programme can be viewed by clicking here
4	Prof S. C. Dutta Roy, FNAE, formerly Professor of Electrical Engineering, IIT Delhi received the 2021 Signal Processing Society Award in recognition of his half a century of teaching various facets of Signal Processing, which have changed the lives and careers of millions of students across the globe, through his classes and online lectures".
5	Prof. Sankar K. Pal, FNAE, Former Director and Distinguished Scientist, Indian Statistical Institute, Kolkata; formerly INSA Distinguished Professor; JC Bose National Fellow and formerly DAE Raja Ramanna Fellow and formerly INAE Chair Professor has been selected as a AICTE nominated AICTE Distinguished Chair Professor. He has also been elected a Fellow, Asia-Pacific Artificial Intelligence Association (AAIA).
6	Prof Sanjit K. Mitra, FNAE, Professor Emeritus of Electrical & Computer Engineering, University of California, Santa Barbara, USA has been elected as a corresponding member of the Academia Nacional de Engenharia (Brazilian Academy of Engineering).
7	Prof. Rajpal S. Sirohi, FNAE, Padma Shri, Former Director, IIT Delhi and Former VC Barkatullah University) received two awards in the year 2021 viz. IITD Alumni-Faculty Award 2021-2022 and Maria J. Yzuel Educator Award 2022 from SPIE - The International Society for Optics and Photonics. The SPIE Maria J. Yzuel Educator Award is presented annually in recognition of outstanding contributions to optics education by an SPIE instructor or an educator in the field. The SPIE Awards Committee recommended Prof Rajpal S Sirohi for the award in recognition his many years of service in the field of optics through leadership, capacity building and outreach.

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News of Fellows

1	Mr S Somanath, FNAE Formerly Director, Vikram Sarabhai Space Centre; Former Director, Liquid Propulsion Systems Centre (LPSC), Trivandrum has taken over as the Chairman, Space Commission, Chairman, ISRO and Secretary, Department of Space, Government of India. Please see the link given below for Update from ISRO regarding the same. https://www.isro.gov.in/update/14-jan-2022/shri-s-somanath-assumes-charge-secretary-department-of-space
2	Prof Rangan Banerjee, FNAE, Forbes Marshall Chair Professor, Department of Energy Science and Engineering, Indian Institute of Technology Bombay, Mumbai has been appointed as Director of IIT Delhi. For news regarding the same please click on link given below. https://indianexpress.com/article/india/iit-delhi-gets-new-director-7716590/
3	Prof Laxmidhar Behera, FNAE, Poonam and Prabhu Goel chair professor of electrical engineering at the IIT, Kanpur has been appointed as Director, IIT Mandi as per news link given below. https://www.ndtv.com/education/iit-mandi-appoints-new-director-laxmidhar-behera-from-iit-kanpur-iitmandi-ac-in
4	Prof. Suhas Joshi, FNAE, Rahul Bajaj Chair Professor and Dean, Department of Mechanical Engineering, Indian Institute of Technology Bombay, Mumbai has been appointed as Director, IIT Indore. Further details may be viewed at the link given below. https://www.timesnownews.com/education/article/iit-indore-gets-a-new-director-all-you-need-to-know-about-professor-suhas-joshi/848368
5	Dr. K Kasturirangan, FNAE, Padma Vibhushan, Former Chairman, ISRO; Former Chairman, NEP Committee and former President, INAE delivered the 15th National Institute of Education Planning and Administration (NIEPA) Foundation Day Lecture on "Liberal Education: A 21st Century Imperative" on August 11, 2021. A copy of the lecture can be viewed by clicking here
6	Dr. BHVSN Murthy, FNAE, Distinguished Scientist and Director General (MSS), Ministry of Defence, DRDO delivered a Lecture on "Role of Artificial Intelligence in Missile Applications" on December 9, 2021.
7	Dr. Samir V Kamat, FNAE, Distinguished Scientist and Director General (Naval Systems & Materials), Ministry of Defence, DRDO delivered a Lecture on "Materials for Defence: Challenges and Opportunities" on 17th Jan 2022 through Online Video Conferencing (Webex Platform).
8	Mr S N Subrahmanyan, CEO & MD, Larsen & Toubro Ltd., Mumbai has been appointed one of nine founding members of Climate Finance Leadership Initiative (CFLI) India in recognition of L&T's leadership in climate and infrastructure finance. Mr Subrahmanyan has joined CFLI's CEO Forum, representing L&T, as one of the two corporate conglomerates outside the financial sector. This follows an announcement by the UN Special Envoy for Climate Action and Solutions, Mr Michael R Bloomberg.
9	Prof. Pradip K. Tewari, FNAE, Head, Department of Chemical Engineering, IIT Jodhpur delivered an online Lecture on "Water Issues in Rural Areas: IIT Jodhpur Interventions" during the Indian Women Scientists' Association (IWSA) is organizing 17th Talk under IWSA's Science and our Life Lecture Series on August 14, 2021.

10	Prof K. Ramesh, FNAE, K Mahesh Chair Professor, Department of Applied Mechanics, IIT Madras, Chennai has authored a book on "Developments in Photoelasticity - A Renaissance" published by IOP (Institute of Physics), UK. The details of the book can be seen in the link. https://iopscience.iop.org/book/978-0-7503-2472-4
11	Prof SN Mukhopadhyay, FNAE, Adjunct Professor, Department of Biological Sciences, BITS, Pilani and Former Professor, DBEB, IIT Delhi; Former Professor & Head, BERC, IIT Delhi; Former Professor SOBT, GBU, Greater Noida, has forwarded abstract on "God Particles (GPs) Regulated LHGBRs Exposures to Space Environment in their Space Ventures" which has been accepted for presentation at the International Conference on Space Tourism Centre for Aviation and Space Laws at NUJS, Kolkata being held in January 2022.

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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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Articles by INAE Fellows

- Article by Prof. M.R. Madhav, Professor Emeritus, JNT University; Visiting Professor, IIT, Hyderabad

Radhanath Sikdar

The Human Computer who established the Height of Everest

Madhav Madhira

All of us know that Mt Everest is the tallest mountain on earth at a height of 8,848 m and still growing. However, few of us know the mathematical genius who did the calculations to establish the height and thus vault the mountain to peak of all others. This write up is to bring to attention and credit the person, Radhanath Sikdar, for his role and contribution to the effort of identifying Everest as the tallest mountain so he may join the pantheon of eminent galaxies of our scientific community of pre-Independence era.

George Everest is one of the greatest surveyors of the nineteenth century (1823 – 1845) following William Lambton, the first Surveyor General of India, who started the Great Trigonometrical Survey of India called 'The Great Arc'. No wonder Everest was recognized as the greatest surveyor. When he took over in 1823, less than half of 1800 miles of the length of the country was surveyed in the previous two decades by Lambton. Everest during his convalescence in England learnt the latest advances in surveying and geodesy and built two of the most advanced/accurate (at that time) theodolites and brought them with him to India. The theodolites weighed half a ton each and had to be carried by twelve porters three at each end of two poles.

The Great Trigonomical Survey reached the Northern end just short of Nepal in 1843 but sadly George Everest's health deteriorated rapidly. He wrote 'I was confined to be without intermission during which I was bled to fainting and had upwards of 1,000 leaches and 30-40 cupping glasses … besides daily doses of nauseous medicines ..'. He has to be carried and placed in the surveyor's chair by two assistants. Soon after he decided to quit and returned to England. Andrew Waugh succeeded George Everest and extended the survey along the North-East Longitudinal Series starting from about 1845. Kanchenjunga was measured to be 28,176 ft (8,588 m) high in 1847 higher than Nanda Devi belived to be the highest till then. Waugh then made observations of a distant peak identified firstly as 'b' and then as 'gamma', that was possibly higher than Kanchenjunga.

Waugh gave the job of measuring this peak now termed as XV to James Nicholson. Nicholson took reading from six different peaks around Darjeeling and gave the data to Radhanath Sikdar and his team of 'computers' in Calcutta in 1849-50.

Radhanath Sikdar was born to Bengali parents on Oct. 5, 1813 to Tituram Sikdar and Devki Sikdar in the Jorasanko district of Calcutta. He and his brother, Srinath, both earned scholarship to study in the village school. Sikdar used the money to buy books and read while his younger brother used his to support the family. Sikdar joined the Hindu College (Presidency College/University, Kolkata now) in 1824 at the age of 11 years. It is said that he studied Euclidean Geometry and one of the two Indian students ever to study Isaac Newton's *Principia Mathematica* completely.

George Everest in search of someone proficient of spherical geometry, wrote to Prof. Tytler under whom Sikdar studied, for names of outstanding students. Prof. Tytler unhesitatingly recommended Sikdar as 'the star student'. Sikdar joined Survey of India with a salary of Rs 30/- per month in 1831 at the young age of 20 years. He worked on the line linking Barrackpore to Calcutta. He moved to Dehradun three years later to work directly alongside Everest. Admiration of George Everest for Sikdar can gleaned

from the following statement by Everest "Of the qualification of the young man,' 'I cannot speak too highly … In his mathematical attainments there are few in India, whether European or native, who can at all compete with him, and even in Europe his attainments would rank high".

Few year later when Sikdar wanted to get transferred to become Deputy Tax Inspector for better pay, George Everest stopped the transfer with the following comment: 'The young Indian's qualifications, so eminently valuable to my Department, would be thrown away upon that to which he now seeks to be transferred. He has become… my right arm in all matters connected with computation and registry of data, and the loss of his services at this critical moment would be one of the most severe privations that could be inflicted upon us'. Sikdar got himself transferred from Survey department at Dehradun to become 'Computer' in the Calculations Department' headquartered at Calcutta. Waugh, Everest's successor, also felt likewise and promoted Sikdar to 'Sub-assistant'.

That is not all. A report submitted to the British Parliament had this encomium about Sikdar 'a more loyal, zealous, and energetic body of men is no-where to be found'. Among them may be mentioned as most conspicuous for ability, Babu Radhanath Sikdar, a native of India of Brahminical extraction whose mathematical attainments are of the highest order'. Soon after, Sikdar was appointed as Chief Computer and Head of the Survey's entire calculating and computing department.

Sikdar and his team started working on the data gathered and submitted on peak XV by Waugh, Armstrong, Nicholson, etc. The results were obtained by different people from different locations and at different times. Obviously not all of them were consistent. Sikdar and his team used advanced theories of refraction, plumb-line deflection, gravity, geoids, datums of reference, etc. that were complex that even several geographers found difficult to follow. It took two years for the calculations to be made and only towards the end of 1852 were the result communicated to Waugh, in the Archimedian way; Sikdar ran breathless to Waugh's office exclaiming 'Sir, I have discovered the highest mountain of the world'. However, the veracity of this incident has never been verified for Sikdar was in Calcutta and Waugh in Dehradun!!! Possibly Sikdar exclaimed to his local boss or his colleague. It took four more years for Waugh to check the results with corrections for light refraction, barometric pressure, temperature, gravity, and tidal observations that were gathered from Karachi. Waugh finally communicated the momentous observation to the world in March 1856.

It is interesting to note that Sikdar's calculations yielded the height as 29,000 ft but it being a round figure, it was given as 29,002/3 ft. Hundred and fifty years later with all the latest technologies, observations, theories and knowledge, the height is 29,029 ft or 8,848 m accurate to 99.99%!!!

The naming of XV as Mount Everest has also been an enigma as all other Himalyan peaks have been given local names such as Nanda Devi, Annapurna, Kanchenjungha, Dhaulagiri, etc. Nepal and Tibet in which the peak XV is located were out of bounds for the British and they were unaware of the local Tibetian name 'Chomolungma' though this name figured in a French map as far back as 1733 as 'Tchoumour-Lancma', meaning 'Mother Goddess of Earth' in Tibetan language.

Radhanath Sikdar retired from Survey of India in 1862 and died in 1870.

Bibliography

Keay, J. 2000. The Great Arc: The Dramatic Tale of How India was Mapped and Everest named. Harper Collins.
Storti, C. 2021. The Hunt for Mount Everest. John Murray, UK.

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Obituaries

The Academy has learnt of the sad demise of the Fellows in the recent past and expresses deep condolences to their families and colleagues. The Obituaries of Fellows who passed away before January 31, 2022 are given below.

Prof. Surjya Kumar Maiti

(July 29, 1948- December 2, 2021)

Prof Surjya Kumar Maiti, Visiting Professor, Mechanical Engineering Dept., IIT Bhilai, and former Professor, Mechanical Engineering Department, Indian Institute of Technology, Bombay Mumbai was born on July 29, 1948 and passed away on December 2, 2021. He had more than thirty-five years of teaching and research experience and had published nearly 100 papers in national and international journals. He received his B.E. (Mech) from Burdwan University in 1970; MSc from Birmingham University in 1973 and PhD from the Indian Institute of Technology, Bombay, and worked as postdoctoral assistant at the University of Cambridge for two years (1981–1983). He had authored a book on 'Fracture Mechanics: Fundamentals and Applications', Cambridge University Press 2015. He had made significant research contributions in the areas of Fracture Mechanics covering Stable and unstable crack growth, crack arresters, computational fracture mechanics, crack-crack interactions, residual stress effects, interface cracks in bimaterials, and nondestructive detection of cracks; Finite element methods covering Elastic-plastic stress analysis, kinked crack problems, analysis of crack-stiffened panels, multiple points singularity elements, and thermal stress analysis and Boundary element methods covering Stress and vibration analysis.

Prof Maiti received several awards and honours including Fellowship of INAE and National Academy of Science of India; G.K. Devarajulu Chair Professorship in Mechanical Engg., Fellowship of American Society of Mechanical Engineers; Excellence in Teaching Award 2006, IIT Bombay; Fellowship of Institution of Engineers (India); Membership of ASME and was Member, Queens' College, Cambridge University and Royal Society Commonwealth Bursary for Postdoctoral Research.

May God bless his soul to Rest in Peace

Prof. KN Seetharamu

(August 22, 1939- 2022)

Prof KN Seetharamu, Chair Professor in Thermal Engg., Dept of Mechanical Engg., PESIT, Bangalore and former Professor, IIT Madras born on August 22, 1939 passed away in January 2022. Prof K.N Seetharamu graduated from Mysore University in Mechanical Engineering in the year 1960. He obtained his Masters Degree in Power Engineering in the year 1962, from Indian Institute of Science, Bangalore. He obtained his doctoral degree in 1973, in the field of heat transfer from Indian Institute of Technology, Madras. His doctoral thesis was judged as one of the excellent theses by Prof. Rohsenow from MIT, a world-renowned person in the field of heat transfer. He had an industrial experience of more than 3 years (Oct. 1962 - Dec. 1965) in a paper mill before he joined the academic life. He served BIT Ranchi as an Assistant Professor from 1965-1968. He joined Indian Institute of Technology, Madras in the year 1968, as a lecturer and rose to the level of Professor in the year 1980. He joined the School of Mechanical Engineering, University Science Malaysia as a Professor in the year 1996 on invitation. He took voluntary retirement from IIT Madras in September 1998 to continue his assignment at University of Science Malaysia.

His areas of interest were heat transfer, fluid flow, stress analysis, energy systems, electronic packaging, and FEM applications to engineering problems. He was also working on the application of ANN and GA for optimization problems. He had contributed extensively in the areas of Porous Medium, Heat Exchangers, Thermal Management in Electronic Systems etc. He was active in the application of FEM to CFD and Financial Problems. Prof. Seetharamu had supervised 30 students for Ph.D Degree and 32 students for Masters Degree by research. 18 students had completed their Masters Degree by research in the area of electronic packaging. He had published a large number of research papers in peer reviewed journals and books on “FEM Applications to Heat Transfer”, published by John Wiley in 1996 along with co-authors from UK; “Fundamentals of FEM in Heat and Fluid Flow” through John Wiley in April 2004 and “Engineering Fluid Mechanics” with Prof. PA Aswatha Narayana in June 2004. He had carried out many national and international collaborative projects. He had also contributed a chapter on thermal management in the book “Fundamentals of Microsystems Packaging” edited by Rao Tummala and published by McGraw-Hill in 2001; chapters in “Modeling in Welding, Hot Powder Forming, and Casting” book edited by Lennart Karlsson, published by American Society of Metals in 1997; and a chapter in the book “Handbook of Residual Stress and Deformation of Steel” published by ASM in 2002. Prof. Seetharamu established IMAPS Malaysia Chapter in the year 1998 and IEEECPMT Malaysia Chapter in the year 2000 and continued to be active in this area. Prof Seetharamu was also active in offering continuing education programs to multi-national companies like Agilent, Intel, AMD etc. on the applications of Finite Element Method to electronic packaging as well as Thermal Management in Electronic Systems. He had joined PES Institute of Technology, Bangalore as a Chair Professor in Thermal Engineering in August 2007.

May God bless his soul to Rest in Peace

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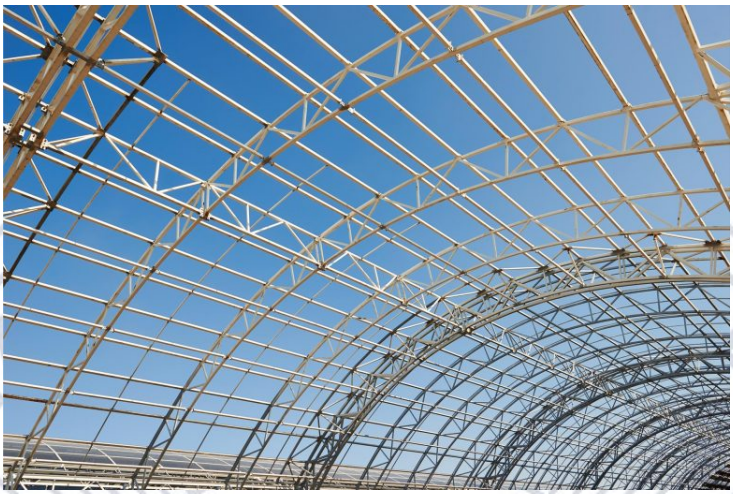
Engineering And Technology Updates

Civil Engineering

1. Steel or Timber? New Tools Help Builders Reduce Carbon Footprint of Truss Structures



Buildings are a big contributor to global warming, not just in their ongoing operations but in the materials used in their construction. Truss structures — those crisscross arrays of diagonal struts used throughout modern construction, in everything from antenna towers to support beams for large buildings — are typically made of steel or wood or a combination of both. But little quantitative research has been done on how to pick the right materials to minimize these structures' contribution global warming. The "embodied carbon" in a construction material includes the fuel used in the material's production (for mining and smelting steel, for example, or for felling and processing trees) and in transporting the materials to a site. It also includes the equipment used for the construction itself. Now, researchers at MIT have done a detailed analysis and created a set of computational tools to enable architects and engineers to design truss structures in a way that can minimize their embodied carbon while maintaining all needed properties for a given building application. While in general wood produces a much lower carbon footprint, using steel in places where its properties can provide maximum benefit can provide an optimized result, they say. The two main options in reducing the carbon emissions associated with truss structures, she says, are substituting materials or changing the structure. However, there has been "surprisingly little work" on tools to help designers figure out emissions-minimizing strategies for a given situation, she says. The new system makes use of a technique called topology optimization, which allows for the input of basic parameters, such as the amount of load to be supported and the dimensions of the structure and can be used to produce designs optimized for different characteristics, such as weight, cost, or, in this case, global warming impact. Researchers at MIT have created a set of computational tools to enable architects and engineers to design truss structures in a way that can minimize their embodied carbon while maintaining all needed properties for a given building application. Wood performs very well under forces of compression, but not as well as steel when it comes to tension. The tools they developed can be applied at different stages, either in the early planning phase of a structure, or later on in the final stages of a design. As an exercise, the team developed a proposal for reengineering several trusses using these optimization tools and demonstrated that a significant savings in embodied greenhouse gas emissions could be achieved with no loss of performance.

Source https://scitechdaily.com/steel-or-timber-new-tools-help-builders-reduce-carbon-footprint-of-truss-structures

2. System Recognizes Hand Gestures to Expand Computer Input on a Keyboard

Researchers are developing a new technology that uses hand gestures to carry out commands on computers. The prototype, called "Typealike," works through a regular laptop webcam with a simple affixed mirror. The program recognizes the user's hands beside or near the keyboard and prompts operations based on different hand positions. A user could, for example, place their right hand with the thumb pointing up beside the keyboard, and the program would recognize this as a signal to increase the volume. Different gestures and different combinations of gestures can be programmed to carry out a wide range of operations. The innovation in the field of human-computer interaction aims to make user experience faster and smoother, with less need for keyboard shortcuts or working with a mouse and trackpad. The initial insight led to the development of a small mechanical attachment that redirects the webcam downwards towards the hands. The team then created a software program capable of understanding distinct hand gestures in variable conditions and for different users. The team used machine learning techniques to train the Typealike program. "It's a neural network, so you need to show the algorithm examples of what you're trying to detect," said Fabrice Matulic, senior researcher at Preferred Networks Inc. and a former postdoctoral researcher at Waterloo. "Some people will make gestures a little bit differently, and hands vary in size, so you have to collect a lot of data from different people with different lighting conditions." The team recorded a database of hand gestures with dozens of research volunteers. They also had the volunteers do tests and surveys to help the team understand how to make the program as functional and versatile as possible. "We're always setting out to make things people can easily use," said Daniel Vogel, an associate professor of computer science at Waterloo. "People look at something like Typealike, or other new tech in the field of human-computer interaction, and they say it just makes sense. That's what we want. We want to make technology that's intuitive and straightforward, but sometimes to do that takes a lot of complex research and sophisticated software." The researchers say there are further applications for the Typealike program in virtual reality where it could eliminate the need for hand-held controllers.

Source https://www.sciencedaily.com/releases/2022/01/220105094430.htm

Mechanical Engineering

3. Rubber Material Holds Key to Long-Lasting, Safer EV Batteries

For electric vehicles (EVs) to become mainstream, they need cost-effective, safer, longer-lasting batteries that won't explode during use or harm the environment. Researchers at the Georgia Institute of Technology may have found a promising alternative to conventional lithium-ion batteries made from a common material: rubber. Elastomers, or synthetic rubbers, are widely used in consumer products and advanced technologies such as wearable electronics and soft robotics because of their superior mechanical properties. The researchers found that the material, when formulated into a 3D structure, acted as a superhighway for fast lithium-ion transport with superior mechanical toughness, resulting in longer charging batteries that can go farther. The research was conducted in collaboration with the Korea Advanced Institute of Science and Technology. In conventional lithium-ion batteries, ions are moved by a liquid electrolyte. However, the battery is inherently unstable: even the slightest damage can leak into the electrolyte, leading to explosion or fire. The safety issues have forced the industry to look at solid-state batteries, which can be made using inorganic ceramic material or organic polymers. Solid polymer electrolytes continue to attract great interest because of their low manufacturing cost, non-toxicity and soft nature. However, conventional polymer electrolytes do not have sufficient ionic conductivity and mechanical stability for reliable operation of solid-state batteries. Georgia Tech engineers have solved common problems (slow lithium-ion transport and poor mechanical properties) using the rubber electrolytes. The key breakthrough was allowing the material to form a three-dimensional (3D) interconnected plastic crystal phase within the robust rubber matrix. This unique structure has resulted in high ionic conductivity, superior mechanical properties and electrochemical stability. This rubber electrolyte can be made using a simple polymerization process at low temperature conditions, generating robust and smooth interfaces on the surface of electrodes. These unique characteristics of the rubber electrolytes prevent lithium dendrite growth and allow for faster moving ions, enabling reliable operation of solid-state batteries even at room temperature. The researchers are now looking at ways to improve the battery performance by increasing its cycle time and decreasing the charging time through even better ionic conductivity. So far, their efforts have seen a two-time improvement in the battery's performance / cycle time.

Source https://www.sciencedaily.com/releases/2022/01/220112121455.htm

Chemical Engineering

4. 'Hand in hand in hand': Three catalysts solve chemical problem

For organic synthesis, i.e. for the production of carbon-based compounds, it is important to develop synthesis processes by which the desired product can be obtained in good yield. At the same time, the processes should be sustainable: for example, they should use environmentally friendly and readily available reagents, generate little waste and consume little energy. New synthesis processes that meet these criteria can serve as a springboard for innovations -- from medicinal chemistry to materials science. One example is so-called transition metal-catalyzed cross-coupling reactions. Unactivated (inert) alkenes are known as starting materials for reaction processes because of their ready availability. By means of arylation, i.e. the insertion of an aryl group, the properties of the compound can be specifically modified. In the current work, the researchers have succeeded in inserting a special functional group -- an aryl group -- directly via catalysis, without multi-step synthesis. Chemists refer to catalysis as the acceleration and control of chemical reactions. Most catalysis reactions require only one catalyst. The three catalysts work hand in hand, so to speak. One of the catalysts is a photocatalyst that makes energy from light available for the reaction. The entire catalyst system is a so-called ternary nickel-hydrogen atom transfer photodox synergy system. "Our redox-neutral photochemical strategy is readily applicable. We can use it to generate compounds with many different properties. Chemists talk about high functional group tolerance and breadth of application," explains researcher Frank Glorius. "We can use it to arylate drug and natural product derivatives selectively at the allyl position. This could be used to improve efficacy or open up entirely new application possibilities." Another researcher adds, "In general, carbon-hydrogen bonds are inert. Using ternary catalysis allows us to selectively use a carbon-hydrogen bond for the reaction and link it to the desired partner." In addition to the synthetic capabilities of the method, the team has been investigating the mechanistic intricacies of this ternary linkage. By combining experimental observations with density functional theory calculations, the scientists have painted a realistic picture of the elementary steps involved in the process. By way of background, the properties of organic compounds are largely determined by so-called functional groups that sit on a framework of carbon atoms. To produce new molecules, functional groups are converted into each other. This often requires multi-step syntheses. It is more favorable to dispense with the functional group and instead produce the desired product directly from a carbon-hydrogen bond ("C-H functionalization"). However, chemists face major challenges in selecting suitable starting compounds and synthesis strategies.

Source https://www.sciencedaily.com/releases/2022/01/220112145129.htm

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Electrical Engineering

5. The First Topological Acoustic Transistor

Topological materials move electrons along their surface and edges without any loss, making them promising materials for dissipationless, high-efficiency electronics. Researchers are especially interested in using these materials as transistors, the backbone of all modern electronics. But there's a problem: Transistors switch electronic current on and off, but it's difficult to turn off the dissipationless flow of electrons in topological materials. Now, Harvard University researchers have designed and simulated the first topological acoustic transistors -- with sound waves instead of electrons -- and proposed a connection architecture to form a universal logic gate that can switch the flow of sound on and off. "Since the advent of topological materials around 2007, there has been a lot of interest in developing a topological electronic transistor," said Jenny Hoffman, the Clowes Professor of Science at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) and the Department of Physics. "Although the materials we used won't yield an electronic topological transistor, our general design process applies to both quantum materials and photonic crystals, raising hopes that electronic and optical equivalents may not be far behind." By using acoustic topological insulators, the researchers were able to sidestep the complicated quantum mechanics of electron topological insulators. "The equations for sound waves are exactly solvable, which allowed us to numerically find just the right combination of materials to design a topological acoustic waveguide that turns on when heated, and off when cooled," said Harris Pirie, first author of the paper. The researchers used a honeycomb lattice of steel pillars anchored to a high-thermal-expansion plate, sealed in an air-tight box. The lattice has slightly larger pillars on one half, and slightly smaller pillars on the other half. These differences in size and spacing of the pillars determine the topology of the lattice, whether sound waves can travel along a designated channel or not. The researchers then designed a second device that converts ultrasound into heat. The heat expands the pillar lattice and changes the topology of the waveguide. When coupled together, these two devices allow the output of one waveguide to control the state of the next, just as the electrons flowing in a conventional transistor can toggle other transistors. These acoustic topological switches are scalable, meaning the same design used with ultrasonic frequencies at the centimeter scale could also work at sub-millimeter sizes and frequencies commonly used to transmit surface acoustic waves, which may help to overcome limitations in integrated phononic circuits. "The control of topologically protected acoustic transport has applications in a number of important fields including efficient acoustic-noise reduction, one-way acoustic propagation, ultrasound imaging, echolocation, acoustic cloaking, and acoustic communications," said Pirie. These acoustic metamaterials could also be used as a teaching tool. "Unlike quantum-mechanical systems, acoustic metamaterials are straightforward, tangible, and intuitive. They serve as an accessible entry point to cutting edge topics in condensed matter physics, including topological insulators," said researcher Hoffman. The team plans to make a public-facing demonstration of these devices that students or museum visitors can touch, toggle, and hear.

Source https://www.sciencedaily.com/releases/2022/01/220105111351.htm

6. Mass Production of Revolutionary Computer Memory Moves Closer With ULTRARAM™ on Silicon Wafers for The First Time

A pioneering type of patented computer memory known as ULTRARAM™ has been demonstrated on silicon wafers in what is a major step towards its large-scale manufacture. ULTRARAM™ is a novel type of memory with extraordinary properties. It combines the non-volatility of a data storage memory, like flash, with the speed, energy-efficiency and endurance of a working memory, like DRAM. To do this it utilises the unique properties of compound semiconductors, commonly used in photonic devices such as LEDS, laser diodes and infrared detectors, but not in digital electronics, which is the preserve of silicon. Now, in a collaboration between the Physics and Engineering Departments at Lancaster University and the Department of Physics at Warwick, ULTRARAM™ has been implemented on silicon wafers for the very first time. Professor Manus Hayne of the Department of Physics at Lancaster, who leads the work said, "ULTRARAM™ on silicon is a huge advance for our research, overcoming very significant materials challenges of large crystalline lattice mismatch, the change from elemental to compound semiconductor and differences in thermal contraction." Digital electronics, which is the core of all gadgetry from smart watches and smart phones through to personal computers and datacentres, uses processor and memory chips made from the semiconductor element silicon. Remarkably, the ULTRARAM™ on silicon devices actually outperform previous incarnations of the technology on GaAs compound semiconductor wafers, demonstrating (extrapolated) data storage times of at least 1000 years, fast switching speed (for device size) and program-erase cycling endurance of at least 10 million, which is one hundred to one thousand times better than flash.

Source https://www.sciencedaily.com/releases/2022/01/220106143222.htm

Aerospace Engineering

7. NASA Satellites Launch Aboard Virgin Orbit's LauncherOne Rocket

Virgin Orbit's LauncherOne rocket detached from the company's CosmicGirl aircraft on January 13, 2022, launching NASA's 29th Educational Launch of Nanosatellites (ELaNa) mission and the 13th CubeSat in the TechEdSat series. This launch, also known as STP-27VPB, lifted off at approximately 4:39 p.m. EST (1:39 p.m. PST) from Mojave Air and Space Port, California. Cornell's Pathfinder for Autonomous Navigation (PAN), the 29th ELaNa mission, will launch two small research satellites known as CubeSats to low-Earth orbit to demonstrate autonomous rendezvous at a low cost. PAN is the first CubeSat mission to attempt docking between two CubeSats and will represent one of the most advanced autonomous CubeSat systems that has flown to date. CubeSats are a class of research spacecraft called nanosatellites, built to standard units, or "U," of 4 inches cubed. Often included as secondary payloads, CubeSats can be 1U, 2U, 3U, or 6U in size, typically weighing less than 3 pounds per unit and designed to carry out unique tasks once deployed into low-Earth orbit. The PAN CubeSats, each measuring approximately 8 inches x 12 inches, feature a cold gas propulsion system, reaction wheel-based attitude control, and GPS navigation. A few months after launch, the satellites will match each other's orbits and rendezvous to demonstrate future capabilities for on-orbit assembly. The nanosatellites will use carrier-differential GPS to autonomously conduct rendezvous and docking operations. This method allows position measurement accurate to within several centimeters. If successful, the technology demonstrated by PAN will reduce the mass and complexity associated with traditional rendezvous and docking systems. PAN was selected through NASA's CubeSat Launch Initiative (CSLI) and assigned to this mission by the agency's Launch Services Program (LSP) based at Kennedy Space Center in Florida. CSLI enables the launch of CubeSat projects designed, built, and operated by students, teachers, faculty, NASA centers, and nonprofit organizations. Managed by LSP, ELaNa missions provide a deployment opportunity or ride-share launches to space for the selected CubeSats. TechEdSat-13, from NASA's Ames Research Center in California's Silicon Valley, is a 3U nanosatellite that carries a unique artificial intelligence/machine learning (AI/ML) module featuring the first orbital flight of a neuromorphic processor. This processor, the Intel Loihi, permits fast and efficient execution of AI/ML algorithms through a unique architecture that, in some ways, mimics the human brain. In addition, there is a unique exo-atmospheric brake that will help rapidly de-orbit this and future nanosatellites. With this exo-brake technology, TechEdSat-13 will help address the accumulation and efficient disposal of orbital debris. This effort also helps to set the stage for autonomous navigation for nanosatellites to drop from orbit and reach their planned destination on Earth. The TechEdSat flight series involves university interns and early career aerospace professionals.

Source https://scitechdaily.com/nasa-satellites-launch-aboard-virgin-orbits-launcherone-rocket

8. Self-Healing Nanomaterials: Self-Repairing Electronics are on the Way

Wear and tear reduce the effectiveness of electronic devices until they need to be replaced. The field of self-repairing materials is rapidly expanding, and what used to be science fiction might soon become reality, thanks to Technion – Israel Institute of Technology scientists who developed eco-friendly nanocrystal semiconductors capable of self-healing. Their findings describe the process, in which a group of materials called double perovskites display self-healing properties after being damaged by the radiation of an electron beam. The perovskites, first discovered in 1839, have recently garnered scientists' attention due to unique electro-optical characteristics that make them highly efficient in energy conversion, despite inexpensive production. A special effort has been put into the use of lead-based perovskites in highly efficient solar cells. The Technion research group of Professor Yehonadav Bekenstein from the Faculty of Material Sciences and Engineering and the Solid-State Institute at the Technion is searching for green alternatives to the toxic lead and engineering lead-free perovskites. The team specializes in the synthesis of nano-scale crystals of new materials. By controlling the crystals' composition, shape, and size, they change the material's physical properties. Nanocrystals are the smallest material particles that remain naturally stable. Their size makes certain properties more pronounced and enables research approaches that would be impossible on larger crystals, such as imaging using electron microscopy to see how atoms in the materials move. This was, in fact, the method that enabled the discovery of self-repair in the lead-free perovskites. The perovskite nanoparticles were produced in Prof. Bekenstein's lab using a short, simple process that involves heating the material to 100°C for a few minutes. When Ph.D. students examined the particles using a transmission electron microscope, they discovered the exciting phenomenon. The high voltage electron beam used by this type of microscope caused faults and holes in the nanocrystals. The researchers were then able to explore how these holes interact with the material surrounding them and move and transform within it. They saw that the holes moved freely within the nanocrystal but avoided its edges. The researchers developed a code that analyzed dozens of videos made using the electron microscope to understand the movement dynamics within the crystal. They found that holes formed on the surface of the nanoparticles, and then moved to energetically stable areas inside. The reason for the holes' movement inwards was hypothesized to be organic molecules coating the nanocrystals' surface. Once these organic molecules were removed, the group discovered the crystal spontaneously ejected the holes to the surface and out, returning to its original pristine structure – in other words, the crustal repaired itself. This discovery is an important step towards understanding the processes that enable perovskite nanoparticles to heal themselves and paves the way to their incorporation in solar panels and other electronic devices.

Source https://scitechdaily.com/self-healing-nanomaterials-self-repairing-electronics-are-on-the-way

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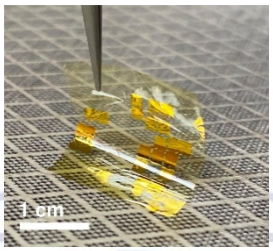
Energy Engineering

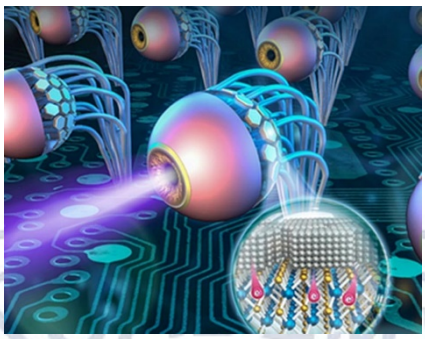
9. **New Photovoltaic Materials Developed by Stanford Scientists for Ultrathin, Lightweight Solar Panels**



New, ultrathin photovoltaic materials could eventually be used in mobile applications, from self-powered wearable devices and sensors to lightweight aircraft and electric vehicles. A race is on in solar engineering to create almost impossibly-thin, flexible solar panels. Engineers imagine them used in mobile applications, from self-powered wearable devices and sensors to lightweight aircraft and electric vehicles. Against that backdrop, researchers at Stanford University have achieved record efficiencies in a promising group of photovoltaic materials. Chief among the benefits of these transition metal dichalcogenides – or TMDs – is that they absorb ultrahigh levels of the sunlight that strikes their surface compared to other solar materials. The search for new materials is necessary because the reigning king of solar materials, silicon, is much too heavy, bulky, and rigid for applications where flexibility, lightweight and high power are preeminent, such as wearable devices and sensors or aerospace and electric vehicles. While TMDs hold great promise, research experiments to date have struggled to turn more than 2 percent of the sunlight they absorb into electricity. For silicon solar panels, that number is closing in on 30 percent. To be used widely, TMDs will have to close that gap. The new Stanford prototype achieves 5.1 percent power conversion efficiency, but the authors project they could practically reach 27 percent efficiency upon optical and electrical optimizations. That figure would be on par with the best solar panels on the market today, silicon included. Moreover, the prototype realized a 100-times greater power-to-weight ratio of any TMDs yet developed. That ratio is important for mobile applications, like drones, electric vehicles, and the ability to charge expeditionary equipment on the move. When looking at the specific power – a measure of electrical power output per unit weight of the solar cell – the prototype produced 4.4 watts per gram, a figure competitive with other current-day thin-film solar cells, including other experimental prototypes. Their biggest benefit, however, is their remarkable thinness, which not only minimizes the material usage and cost but also makes TMD solar cells lightweight and flexible and capable of being moulded to irregular shapes – a car roof, an airplane wing or the human body. The Stanford team was able to produce an active array that is just a few hundred nanometers thick. The array includes the photovoltaic TMD tungsten diselenide and contacts of gold spanned by a layer of conducting graphene that is just a single atom thick. All that is sandwiched between a flexible, skin-like polymer and an anti-reflective coating that improves the absorption of light. When fully assembled, the TMD cells are less than six microns thick – about that of a lightweight office trash bag. It would take 15 layers to reach the thickness of a single piece of paper. While thinness, lightweight, and flexibility are all highly desirable goals in and of themselves, TMDs present other engineering advantages as well. They are stable and reliable over the long term. And unlike other challengers to the thin-film crown, TMDs contain no toxic chemicals. They are also biocompatible, so they could be used in wearable applications requiring direct contact with human skin or tissue. The many advantages of TMDs are countered by certain downsides, mostly in the engineering intricacies of mass production. The process of transferring an ultrathin layer of TMD to a flexible, supporting material often damages the TMD layer. This intricate process results in the TMD being fully embedded in the flexible substrate leading to greater durability. The researchers tested the flexibility and robustness of their devices by bending them around a metal cylinder less than a third of an inch thick.

Source https://scitechdaily.com/new-photovoltaic-materials-developed-by-stanford-scientists-for-ultrathin-lightweight-solar-panels

10. Bionic Eyes: Developing the Next Generation of Artificial Vision Aids



A new technology solution that will provide low-power systems for use in bionic eyes, has been jointly developed by academics from the Harbin Institute of Technology in China and Northumbria University. Researchers described their newly developed method for controlling the artificial synaptic devices used in bionic retinas, robots, and visual prostheses, as a "significant breakthrough." The team discovered that injecting elements of the soft metal, indium, into a two-dimensional (2D) material called molybdenum disulfide (MoS2), could improve electrical conductivity and reduce power consumption of the optical synapses used in the development of bionic eyes. The technology was then tested within the structure of an electronic retina and found to produce the high-quality image sensing functions required. The team's work has been published in a paper called "Ultralow Power Optical Synapses Based on MoS2 Layers by Indium-Induced Surface Charge Doping for Biomimetic Eyes,". A researcher Professor Fu, who is an expert in shape memory, piezoelectric thin films, nano-materials and nanodevices, explained: "The current visual systems are based on physically separated sensors, memories, and processing units. These systems often have high power consumption and difficulties of performing complex image learning and processing tasks. Therefore, our newly developed method is of great significance for the next generation artificial visual systems." Bionic eye implants work inside the existing eye structures or in the brain. They are designed to achieve functional vision goals — as opposed to physical, cosmetic ones. Several bionic eye implants are in development, but currently very few are available, and are suitable only for blindness caused by specific eye diseases. However, as research continues, more and more people may soon benefit from high-tech bionic eyes. Professor Fu's innovative ideas have already contributed to advances in piezoelectric materials-based biosensing and diagnostic tools, cell patterning and manipulation. He also has an international reputation for his work around advancement of shape memory thin films and polymers used in microsurgery and drug delivery. He has developed nano-structured smart materials for gas sensing and renewable energy applications.

Source https://scitechdaily.com/bionic-eyes-developing-the-next-generation-of-artificial-vision-aids

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ENGINEERING INNOVATION IN INDIA

Naval Variant of BrahMos Supersonic Missile Test-Fired from INS Visakhapatnam

An extended range sea-to-sea variant of the BrahMos supersonic cruise missile was successfully test-fired by India from the Indian Navy's newly commissioned INS Visakhapatnam on Tuesday, January 11, 2022, the Defence Research and Development Organisation said. "Advanced sea to sea variant of BrahMos Supersonic Cruise missile was tested from INS Visakhapatnam today. Missile hit the designated target ship precisely," the agency wrote on Twitter. The Navy too said the launch was an achievement. "Successful test-firing of the extended-range BrahMos Supersonic Cruise missile from INS Visakhapatnam, Indian Navy's newest indigenously-built guided missile destroyer, represents a twin achievement: Certifies the accuracy of the ship's combat system and armament complex. Validates a new capability the missile provides the Navy and the Nation," it tweeted. BrahMos, deployed by the Navy on its warships first in 2005, has the capability to hit sea-based targets beyond radar horizon. The naval variant was originally tested in October and December 2020 from the Navy's indigenously-built stealth destroyer INS Chennai and Rajput-class destroyer INS Ranvijay, respectively. This version of the missile has been designed to launch either in a vertical or a horizontal mode from moving/stationary assets to target both land and sea targets. The missiles, fired at a speed of 2.8 Mach or nearly three times the speed of sound, significantly increase the capability of the ships in engaging long-range targets. BrahMos missiles are designed and developed by BrahMos Aerospace, a joint venture company set up by Defence Research and Development Organisation (DRDO) and Mashinostroyenia of Russia.

Source https://indianexpress.com/article/cities/pune/sea-to-sea-variant-of-brahmos-cruise-missile-successfully-tested-from-newly-commissioned-ins-visakhapatnam-7717819

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