INDIAN NATIONAL ACADEMY OF ENGINEERING

E-Newsletter

Vol. XIII, Issue 2, June 2022

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 supports advancement of engineering profession globally

Technology Roadmap

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

It is inevitable that India, like several other nations of the world, will move away from fossil fuels as a source of energy. While we have made some headway in developing renewable energy sources like solar and wind, the necessary infrastructure to support the energy transition does not exist at the present time. INAE plans to create an interdisciplinary expert group to study the whole energy transition comprehensively and holistically, keeping in mind the challenges inherent in such a massive transformation.

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

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

3. Excellence in Engineering Education

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

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

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

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

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

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

4. World Class Infrastructure

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

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

5. Cyber-physical Systems

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

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

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

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

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ACADEMY ACTIVITIES

ACADEMY NEWS

Academy News (Covering period upto to May 31, 2022)

Nominations/Proposals invited for:

- **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/

Important Meetings

1. **ISRO-INAE Consultative Committee Meeting on May 5, 2022**

A meeting of the ISRO-INAE Consultative Committee was held on May 5, 2022 at Bangalore. Besides planning for the conduct of Engineers Conclave 2022, being organized jointly with ISRO at Thiruvananthapuram, the objective of this meeting was also to identify topics for joint collaboration between the two organizations. A meeting of the former Presidents was also held on the sidelines of the meeting to discuss the methodology to take the Academy forward.

Left to Right: Dr V Narayanan, Dr BN Suresh, Mr AS Kiran Kumar, Prof Indranil Manna, Mr S Somanath, Dr PS Goel, Prof Sanjay Mittal and Lt Col Shobhit Rai (Retd) at ISRO, Bangalore

Left to Right: Prof Sanjay Mittal, Prof Indranil Manna, Dr K Kasturirangan, Dr PS Goel and Dr BN Suresh at ISRO, Bangalore

2. DAE-INAE Consultative Committee Meeting on April 22, 2022 at DAE, Mumbai

A meeting of the DAE-INAE Consultative Committee was held on April 22, 2022 at DAE, Mumbai in hybrid mode. The following broad areas were finalized to be taken up for discussion during the first meeting of DAE-INAE Consultative Committee:

i. Energy excluding coal (carbon free energy resources including hydrogen)
ii. Water (including desalination, purification and waste water treatment)
iii. Advanced materials (for nuclear and energy generation units)
iv. Directed beam assisted processing technology (ion, electron, laser) including additive manufacturing and joining

Members of the Committee recommended INAE to organize conferences to bring together academicians, technology developers and users to add value to technology. A few salient areas identified, besides the four above mentioned themes are as follows:

i. Energy harvesting
ii. Sustainable energy solutions for various energy sources excluding Coal
iii. Role of Nuclear energy for production of Hydrogen
iv. Usage of concentrated solar energy for better efficiency than solar energy
v. Effective utilization of all energy resources and user
vi. Rare earth sector (hard magnets)

3. DST-INAE Consultative Committee Meeting on May 27, 2022

A meeting of the DST-INAE Consultative Committee was held at New Delhi on May 27, 2022 to discuss the activities carried out by INAE under the *Azadi Ka Amrit Mahotsav* celebrations, joint projects with SERB, projects undertaken at the behest of DST and constitution of a new Technology

Forum on 'Net-zero Energy Security Policy for India'. The plan for generating funds for achieving self-sufficiency was also discussed.

4. INAE Forum on Energy

A meeting of INAE Forum on Energy was held on February 10, 2022 to discuss issues related to Hydrogen Utilization and Hydrogen Generation. Besides the members of the Forum, about 10-12 invitees were invited to join the discussion so as to formulate INAE Work plan on Hydrogen.

5. INAE Forum on Technology Foresight and Management for addressing National Challenges

INAE Forum on Technology Foresight and Management for addressing National Challenges was constituted in the year 2012. The mandate of the Forum was to evolve solutions keeping in view the issues of sustainable development, poverty reduction, and climate change in focus and suggest appropriate technologies accordingly. This Forum was chaired by Late Mr VK Agarwal, FNAE & Formerly Chairman, Railway Board since 2012. Due to sudden demise of Mr VK Agarwal, the INAE Fellows who were members of this Forum had a virtual meeting on March 9, 2022 to discuss the way forward.

The next Meeting of the INAE Forum on Technology Foresight for addressing National Challenges held on May 13, 2022 in physical mode at INAE office, Ground Floor, Block-II, Technology Bhavan, New Mehrauli Road, New Delhi. The following salient points were discussed (i) The Forum may be renamed as Forum on Technology Foresight and Management - Phase II. That will reflect its effectiveness in phase I and potential in future. (ii) The objectives and tenure will be aligned with the guidelines of any INAE Forum. (iii) It will focus on futuristic technologies in few select areas considered relevant for government programmes (iv) The Forum will develop documents and reports on relevance, policy, strategy, cost-effective technology application route, and various elements of make in India and (v) Following three areas were identified for initial action:

(i) Industry 4.0/5.0 and Emerging Technologies including digitisation.
(ii) Promoting Circular Economy by material management through recovery of materials from e-waste.
(iii) Engineering for Climate Resilience and SDGs.

6. Meeting of INAE Forum on Engineering Interventions for Disaster Mitigation held on April 16, 2022 through VC

A meeting of the INAE Forum on Engineering Interventions for Disaster Mitigation was held on April 16, 2022 through VC. This forum discussed the development of the strategies that would facilitate mitigating natural and manmade disasters that the present-day civilization is witnessing. Apart from a very high priority project on "Valorization of Industrial By-Products" the following two were included in the Forum's new Agenda.

a. Safe & Sustainable multi-hazard risk, resilience infrastructure
b. Sunderbans preservation & eco-friendly infrastructure
c. Interlinking of Rivers
d. (Civil) Engineering Challenges exasperated by urbanization, Climate Change and rapid pace of development
e. Engineering Interventions in Preservation and Protection of Heritage Structures in Hazardous Areas
f. Critical assessment of market-driven new emerging technologies for development in hazardous area

g. Tapping the Power of New Technologies in the context of Disaster Mitigation and the associated Technology Hazards, and
h. Forecasting and Early warning against Multiple Hazards.

The views of the Members were sought by Prof DN Singh, Chairman of the Forum and the way forward was discussed.

EVENTS

National Science Day 2022 Celebrations - Celebration of National Science Day 2022 by INAE Kolkata Chapter

INAE celebrated the National Science Day 2022 on 1st March 2022 and to commemorate this important event, INAE Kolkata Chapter organized online special lectures delivered by **Prof. Ashutosh Sharma,** FNAE, Former Secretary, DST, Govt. of India and Professor of Chemical Engineering Department, IIT Kanpur on **"The Brave New World of Science Today is but the World of J. C. Bose and C.V. Raman: Coming Full Circle"** and by **Dr. Shekhar C. Mande**, Secretary, DSIR and Director General, CSIR, Govt. of India on **"Development of S&T in post independent India"** through WebEx Platform. Prof. Indranil Manna, President, INAE, graced the event and delivered the welcome addresses. He emphasized the importance of the day to the audience and also to the scientific and technical community of the country. Prof. Manna introduced the eminent speakers to the audience.

The first talk of the day was presented by Prof. Ashutosh Sharma, Former Secretary, DST, Govt. of India and Professor of Chemical Engineering Department, IIT Kanpur. The title of the talk was "The Brave New World of Science Today is but the World of J. C. Bose and C.V. Raman: Coming Full Circle". In his lecture, Prof. Sharma portrayed the work and philosophy of two great scientists of India, Acharya Jagadish Chandra Bose and Sir Chandrasekhara Venkata Raman, and emphasized how they continued world-class research in the domestic environment, despite the lack of advanced facilities. He presented their holistic thinking and explained the relevance of their thoughts in today's context. He highlighted the notion of "The Power of Concepts and Ideas", where the true laboratory is the mind. Prof. Sharma also dealt with the present state of research in the country and addressed the young researchers in the audience with his innovative thoughts and wisdom.

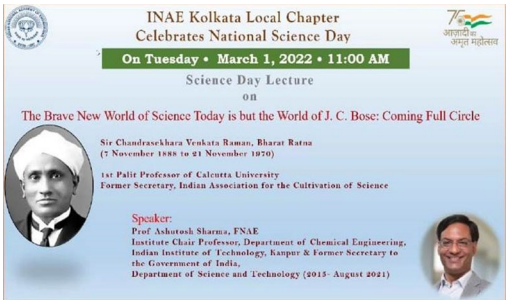
The second talk of the day, held in the evening, was presented by Dr. Shekhar C. Mande, Secretary, DSIR and Director General, CSIR, Govt. of India. His lecture was titled "Development of S&T in post independent India". He began his lecture with the Indian contributions to the scientific developments in the ancient times and presented examples starting from the stone-age to Indus Valley civilization. He continued with the scientific journey in the post-colonial period and illustrated how the building and nurturing of academic and research institutions in the post-independence era helped in the development of science in India. He illustrated examples of some innovative research activities performed in the country and emphasized how simple research initiatives resulted meaningful changes in the lives of the common people. He portrayed the contributions of many Indian luminaries in the development of scientific culture in the country.

Both the talks were extremely informative, full of wisdom and thought which deeply engrossed the audience. Prof. Debatosh Guha, Chairman, INAE Kolkata Chapter offered the formal vote of thanks and expressed gratefulness to both speakers on behalf of the INAE. Lt. Col. Shobhit Rai (Retd), Deputy

Executive Director, INAE oversaw the entire planning of the event. The Lectures were well attended online and appreciated.

Prof. Indranil Manna welcoming the audience

Glimpse of the Museum at Bose Institute, Kolkata



Prof. Ashutosh Sharma delivering his lecture

Dr. Shekhar C. Mande delivering his lecture

INAE Foundation Day Celebrations

Indian National Academy of Engineering (INAE) celebrates its Foundation Day on 20th April each year and this year, INAE Headquarters organized two unique events on 20th April 2022 as given below.

(i) **INAE Foundation Day Function** held from 3PM - 4 PM wherein the Chief Guest was **Dr. PS Goel**, Former President, INAE and Chairperson, National Innovation Foundation-India who delivered an address on "**INAE's Future Direction**". The Presidential Address was delivered by Prof Indranil Manna and briefing on activities in last one year, by the three Vice-Presidents of INAE.

Left to right: Dr PS Goel, Former President, INAE and Prof Indranil Manna, President, INAE

Group Photo of INAE Foundation Day Function with INAE Office Bearers, Fellows and Staff

(ii) **Distinguished Panel Discussion on *"Opportunities and Challenges of Implementation of National Education Policy (NEP) 2020 for Engineering Disciplines and Profession"*** chaired by **Dr K Kasturirangan**, Former Secretary, Department of Space; Former President of INAE & Chairman NEP 2020 Drafting Committee was held on April 20, 2022 from 5 PM to 8:30 PM. *Experts deliberated on opportunities and challenges of implementation of National Education Policy (NEP) 2020 for engineering disciplines and profession* at a panel discussion organised on the occasion of the Foundation Day celebration of the Indian National Academy of Engineering (INAE) on April 20, 2022. The discussion topic was chosen on NEP 2020 since the principal author of the NEP 2020 was Dr K Kasturirangan, former President, INAE and the INAE Fellowship having representation from leading academicians, researchers and industry experts are well suited to share their vast experience and give real-time feedback on NEP 2020 and suggest valuable ideas for its effective implementation, which is vital for the growth of education and in particular engineering education in the country.

The panel discussion was chaired by Dr K Kasturirangan, Former Secretary, Department of Space; Former President of INAE & Chairman NEP 2020 Drafting Committee. Dr K Kasturirangan highlighted

the role that INAE can play in implementing NEP 2020 which could be truly reflective of highest of intellectual inputs and help formulate a roadmap for implementation. He further brought out that though NEP covers the entire spectrum of education right from school education to University level, the issues related to engineering education and its focus in the implementation of NEP in all engineering colleges and institutions in the country were of paramount importance and the subject of the initiative.

The celebrations also included five satellite events steered by the present or former Directors of IIT Kharagpur, IIT Delhi, IIT Bombay, IISc Bangalore and IIT Hyderabad. While Professor PP Chakrabarti, Former Director, IIT Kharagpur elaborated on academic aspects, Prof V Ramgopal Rao, Former Director, IIT Delhi spoke on the accreditation and higher education; Prof Subhasis Chaudhuri, Director, IIT Bombay focused on administrative aspects applicable to technical institutions. Prof Anurag Kumar, Former Director, Indian Institute of Science, Bangalore spoke on R&D and industrial sector and Prof BS Murty, Director, IIT Hyderabad focused on teaching. The satellite events comprised of online discussion meetings covering various aspects of engineering education pertaining to NEP and the Panelists comprised of leading academicians and industry experts including lady representatives in leadership roles who deliberated on the chosen topics and formulated actionable recommendations.

The respective Convener of these five satellite events presented these recommendations before the subject Panel on April 20, 2022. The overarching objective of this entire exercise was to formulate actionable recommendations on the theme for the successful implementation of NEP 2020 in realistic stages and timeline through the concerned stakeholders in the Government Agencies, Academic Institutions, Industry and R&D Organizations. Some of the important recommendations included that Autonomy must go hand in hand with accountability; Internationalization is absolutely essential from the point of building cultural diversity on our campuses; need for high quality teaching faculty and to invest in physical infrastructure to enable the teaching to be more hands on and upgrade them periodically; *Atma Nirbhar* initiatives should be technology driven; expansion of Accessibility of Resource Base; need for Next-Generation Faculty Development; National Research Foundation will need to enhance the current research funding ecosystem; emphasis on the Government-Universities-Industry linkages in research and measures to make engineering education more inclusive and encourage diversity. These recommendations would be followed up with the concerned Government departments and would indeed help in the widespread implementation of NEP across the nation.

The session was moderated by Professor Indranil Manna, President, INAE and Vice-Chancellor, BIT, Mesra and Professor Sivaji Chakravorti, Vice-President, INAE and Professor, Electrical Engg Department, Jadavpur University, Kolkata and former Director, NIT Calicut. Prof Indranil Manna mentioned that the Apex Committee, the think tank of INAE has envisaged this event and had planned the event to make it meaningful and achieve the objectives of implementation of NEP in the country by deliberating on all relevant opportunities and challenges. Prof Sivaji Chakravorti re-iterated that he had participated in all the five satellite events and the outcome of deliberations covering a spectrum of aspects related to NEP 20202 and its implementation in engineering colleges/institutions in the country were pertinent and the same would be compiled and forwarded to the concerned Government departments/agencies for necessary follow up actions to take this initiative to its logical conclusion.

Subsequent to the presentations by the five Conveners during the Distinguished Panel Discussion, views on the subject were invited from the invited Panelists who included Prof. M Jagadesh Kumar, Chairman, UGC; Prof Anil D. Sahasrabudhe, Chairman, AICTE; Prof. Sandeep Verma, Secretary SERB; Dr. Ananya Mukherjee, Vice-Chancellor, Shiv Nadar University; Vice-Chancellor, Dr. S. Vaidhyasubramaniam, Sastra University, Thanjavur; Dr Debashish Bhattacharjee, VP Technology & New Materials Business, Tata Steel Ltd. & Rep CII; Senior Industry Fellows viz Mr Senapathy Kris Gopalakrishnan, Co-founder Infosys & Chairman Axilor Ventures and Mr. MV Kotwal, Formerly

Member of the L&T Board & President Heavy Engineering ; Dr. PS Goel, former President of INAE; Prof Purnendu Ghosh, Prof AB Pandit, and Prof Sivaji Chakravorti- Vice-Presidents of INAE; Dr DK Sharma, Rep of Secretary, Higher Education, Government of India and other distinguished invitees. Prof Indranil Manna, President, INAE responded to the suggestions and the final comments were delivered by Dr K Kasturirangan, Chair of the event who expressed that this initiative of INAE is unique and will have a great impact in the implementation of NEP 2020 through formulation of pertinent actionable recommendations. A comprehensive set of steps which are required to be taken shall be enumerated in the report which shall emerge out of this discussion and set the tone for further deliberations which shall be followed up with concerned Government Departments/stakeholders for furtherance of the initiative.

Left to Right: *Dr K Kasturirangan, Chair and Prof Indranil Manna, President, INAE*

Group Photo of Panelists: from Left to Right

Sitting: *Prof Anil D. Sahasrabudhe, Dr PS Goel, Prof. M Jagadesh Kumar, Dr K Kasturirangan, Mr Senapathy Kris Gopalakrishnan, Dr. Ananya Mukherjee and Mr. MV Kotwal*

Standing: *Prof PP Chakrabarti, Prof. Sandeep Verma, Prof Sivaji Chakravorti, Prof Indranil Manna, Dr. S. Vaidhyasubramaniam, Prof Purnendu Ghosh and Dr Debashish Bhattacharjee*

INAE Bangalore Chapter organized INAE Foundation day on April 23, 2022 with four Focussed Lectures on AI and Sustainable technologies. The lectures were delivered by four leading experts. The Welcome address was delivered by Prof. S. Gopalakrishnan, Aerospace Department and Secretary INAE Bangalore Chapter. The Introduction of Speakers was done by Prof. Neelesh Mehta, Professor, Department of ECE, IISc and Treasurer, INAE Bangalore Chapter. Dr A.P Pratosh, Department of ECE, IISc, Bangalore delivered a talk on "Application of Deep Learning Methods in Health care and Behavioural Analysis"; Dr Umakanth Soni, ArtPark, IISc, Bangalore on" Opportunities for building AI & Robotics startups"; Dr L N Rao, Centre for Sustainable Technologies, IISc, Bangalore on "Gasification of Refuse Derived Fuel for value-added Products" and Prof. Monto Mani, Centre for Sustainable Technologies, IISc, Bangalore on "Sustainability challenges in the built environment". A Report on INAE Bangalore Chapter Activity was presented by Prof. S. Gopalakrishnan, Department of Aerospace Engineering, IISc and Secretary, INAE Bangalore Chapter followed by Address of Dr V K Aatre, Chairman, INAE Bangalore Chapter. The Vote of Thanks was proposed by Neelesh Mehta, Treasurer, INAE Bangalore Chapter.

INAE-NIT Calicut Online Exposition of innovations in Indian Startups

National Institute of Technology Calicut and Indian National Academy of Engineering jointly organised an online exposition contest to showcase the innovative Indian Startups as our country is celebrating the Azadi Ka Amrit Mahotsav marking the 75th year of Independence of India. To get the pan India presence in the expo, NIT Calicut and INAE had invited five organisations in the field of innovation promotion to collaborate for this event. The five organizations associated with this online Exposition were:

1. National Innovation Foundation (NIF)
2. Kerala Startup Mission (KSUM)
3. Startup Innovation and Incubation Centre (SIIC), IIT Kanpur
4. CIIE.CO (IIM Ahmedabad Incubation Centre)
5. Maharashtra State Innovation Society

This expo provided a platform for Indian startups in five significant sectors – (i) Agriculture Technology, (ii) Skilling and Livelihood, (iii) Digital Healthcare, (iv) Clean Mobility and (v) Waste to Wealth; to showcase their innovations virtually using short videos (~ 5 min.). These five sectors are relevant to the current national goals of the Government of India. It was decided that Cash prizes of Rs. 50,000 and Rs. 25,000 will be awarded to the winners and runners up of each sector.

The brochure launch of Online Exposition of Innovation by Startups in India was held at National Institute of Technology, Calicut on 7th February 2022, Monday. The brochure was launched by the Director of NITC, Dr. Prasad Krishna and INAE Vice President Prof Sivaji Chakravorti. 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

From 44 entries received, 31 innovative ideas were shortlisted after the preliminary evaluation and were displayed in the virtual expo from 1st – 3rd April 2022, where the viewers were able to post creative comments and cast a vote (like) for one video from each sector. The viewers could interact with the innovators during the interactive session as part of the expo and the link for this was published in the portal. The expo was inaugurated by the President of INAE, Prof. Indranil Manna. Vice President of INAE, Prof. Sivaji Chakravorti, Deputy Director of NIT Calicut Prof. Sathidevi and Registrar of NIT Calicut Prof. Jeevamma Jacob were present during the inaugural session.

There were 2375 viewers who logged in in the site. There were 1062 comments received for the innovations displayed and received 1659 likes together for the 31 innovations. Interactive sessions with the innovators were arranged on both 1st and 2nd April from 5PM to 6PM for the viewers. In these sessions, the innovators presented more details on the innovations exhibited in the portal. The evaluation of the innovations was done by experts from the innovation and entrepreneurship sector, Prof. Swarnendu Sen, Professor of Jadavpur University (and the coordinator of the innovation activities in the university), Dr. Raghavendra Prasad (former Exe. Director of PSG STEP and an entrepreneur) and Sri. Nizamuddin Mohammed (CEO of Maker Village, Kochi) were the evaluators for the expo. While deciding the winners, along with the marks awarded by the evaluators, the weightage for the votes (likes) received also was considered.

In the valedictory session conducted on 3rd April 2022 which was presided over by the Director of NIT Calicut Prof. Prasad Krishna, INAE Vice President Prof. Sivaji Chakravorti announced the winners of each of the sector. The details of the winners are given below:

a. **Agriculture Technology**: First prize to Cococubes International Foods & Beverages Pvt. Ltd for the product Natural Healthy Energy Drink from Coconut and second prize to Neerx Technovation Pvt. Ltd. for the innovation SHOOL: Smart Sensor for hydrology and land Application.

b. **Skilling and Livelihood**: First prize was given to the innovation IP Buddy (One stop solution for all your IP needs). As there were no other candidate who received more than 50% marks, the second prize was not given in this category.

c. **Digital Healthcare**: Medgyor Pvt Ltd won the first prize for the innovation Affordable isolation room for burns and MIRTH was given the second prize.

d. **Clean Mobility:** Silov Solutions Pvt. Ltd won the first prize for the innovation Smart, Green and intelligent EV charger and Raptor X received the second prize.

e. **Waste to Wealth**: Mr. Jayaprasobh J P won the first prize with the innovation Coco Bio composites for daily use plastic and wood alternative applications. As there were no other candidate who received more than 50% marks, the second prize was not given in this category.

Sri. Rajiv NP, Vice Chairperson of National Innovation Foundation addressed the innovators during the valedictory session and explained the importance of innovation and opportunities for the startups especially from the grass root level.

Local Chapter Activities

INAE Bangalore Chapter

The **SAMVAAD Lecture Series** is joint initiative of IIT Dharwad-INAE Bangalore Chapter.

6th SAMVAAD Lecture 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. Dr Kota Harinarayana, a Padma Sri awardee and former Programme Director and Chief Designer of India's Light Combat Aircraft (LCA) Tejas Programme, delivered a very enthralling talk on "***Aatmanirbhar* Bharat In Aviation-- From Light Combat Aircraft to Regional Transport Aircraft Development".** The 6th SAMVAAD talk was organized on Google Meet online video conferencing platform on 27th October 2021 at 4 pm.

The talk captured the efforts of us becoming *Aatmanirbhar* in aviation technology and was simultaneously streamed on YouTube (https://www.youtube.com/watch?v=zgrxplILhVc) for the benefit of a wider audience including fraternities from technical institutes in Karnataka and CFTIs.

7th SAMVAAD Lecture 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".** AICTE chairman, Prof. Anil D Sahasrabudhe delivered **7th SAMVAAD** talk on 24th November 2021 on Google Meet online video conferencing platform. The talk was on empowering students through NEP. Prof. Anil D. Sahasrabudhe highlighted the essence of NEP and its role in enabling students for holistic development. For benefit of wider audience, the talk was live-streamed on YouTube: (https://www.youtube.com/watch?v=ugHLflPa6-E&t=373s).

8th SAMVAAD Lecture– Prof Pradeep Mujumdar, a JC Bose National Fellow and Professor, delivered a talk on "**Floods in a Changing Climate: An Emerging Engineering Challenge".** This talk was organized on Google Meet online video conferencing platform on 28th January 2022 at 4 pm. The talk captured the increased climate variability under climate change and the risk of hydrologic extremes of floods and was simultaneously streamed on YouTube (https://www.youtube.com/watch?v=A8FgBn7_c88) for the benefit of a wider audience including fraternities from technical institutes in Karnataka and CFTIs.

9th SAMVAAD Lecture -Shri Y. B. Ramakrishna, Member - Working Group on Bio Fuels, MoP & NG, delivered 9th SAMVAAD talk on 23th February 2022 on Google Meet online video conferencing platform. The talk was on **National Biofuel Policy & Initiatives -evolving ecosystem".** Shri Y. B. Ramakrishna highlighted the efforts taken by India in the direction on Biofuels and its various applications. For benefit of wider audience, the talk was live-streamed on YouTube: (https://www.youtube.com/watch?v=aiB8czP01n4).

10th "SAMVAAD Lecture- INAE Bangalore Chapter organized a **live session of 10th "SAMVAAD – an IIT Dharwad-INAE** Bangalore Chapter Lecture Series" on 30th March 2022 (Wednesday) wherein a Lecture on "IIT System and Excellence-Issues and Concerns" was delivered by Prof. S. S. Murthy, Adjunct Professor, NIAS, Bangalore and IIT Ropar.

11th "SAMVAAD Lecture - INAE Bangalore Chapter organized a **live session of 11th "SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series" on 27th April 2022 (Wednesday) from 4 PM - 5:00 PM (IST)** wherein a **Lecture on "Kaleidoscopic flow in a liquid pool due to falling drops" was delivered by** Prof. Gautam Biswas, FNAE, Professor and JC Bose National Fellow, Dept of Mechanical Engineering, IIT Kanpur.

12th "SAMVAAD Lecture -INAE Bangalore Chapter organized a **live session of 12th "SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series" on 25th May 2022 (Wednesday) from 4 PM - 5:00 PM (IST)** wherein a **Lecture on "Research, Innovation and Entrepreneurship at IITs for *AtmaNirbhar Bharat*"** was delivered by Prof. Ashok Misra, FNAE, NASI Platinum Jubilee Chair Distinguished Professor, IISc., Bangalore and Former Director, IIT Bombay.

The video links for the 10th, 11th and 12th lectures will be featured in the next issue of the e-newsletter.

One-day Workshop on "Technologies for Transformation of Indian Agriculture"

INAE Bangalore Chapter also 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 Workshop report can be viewed by clicking here….

INAE Bangalore Chapter Frontiers of Engineering Webinar by Prof Navakanta Bhat on **"Sensor Scaling for Intelligent Heterogeneous Systems"** was held online on October 28, 2021. On Oct. 28, 2021, Prof. Navakanta Bhat from the Center for Nano Science (CENSE), Indian Institute of Science, Bangalore, gave a talk on sensor scaling for intelligent heterogeneous systems. He made the case that the stage is now set for a new wave of electronic systems to be equipped with massive sensory functions, specifically with biological and chemical sensors that go beyond the conventional compute and storage paradigm. He pointed out that not much attention has been given to develop a holistic approach to manage the diversity and scaling issues of sensor blocks. He then presented two case studies from his research. The first one was on biosensor systems for point of care diagnostics. The second was on gas sensor systems for environmental monitoring, breath analysis and hazardous gas leakage detection, with an eventual goal to realize an electronic nose. The talk was attended by about 30 attendees.

INAE Chennai Chapter

INAE Chennai Chapter organized a Webinar on **"An R&D Road Map for Indian eMobility -2022 to 2030"** on **Saturday, 19th February 2022** through WebEx Platform to commemorate celebration of India's 75th Year of Independence (*Azadi ka Amrit Mahotsav*). **Mr Karthick Athmanathan,** Senior VP at Ashok Leyland, Professor of Practice at IIT Madras delivered the said lecture. Approximately 40 people attended the webinar. Apart from the speaker, there were three panelists – Prof. S. Narayanan, the president of INAE Chennai Chapter, Prof. Shankar Ram, a member of the Executive Council of INAE Chennai chapter and also the moderator and Prof. Nandita DasGupta, the secretary of INAE Chennai chapter.

Prof. Narayanan initiated the proceedings by welcoming the guests. He then introduced the speaker Mr Karthick Athmanathan, who is a Senior VP at Ashok Leyland and also a Professor of Practice at IIT Madras. In his talk, Prof. Athmanathan gave a comprehensive picture of the technology status and roadmap of e-mobility in India as well as in the global context. He projected both short-term and long-term roadmap for the different segments – e-rickshaw, e-cars, LCVs, buses and trucks and also discussed the problems/potential in each sector. He also discussed schemes and tools to enable this RoadMap and pointed out certain segments where India can be a world leader. He said that all sectors namely, Industry, Academia, and Government should work together to make this happen. Prof. Karthick Athmanathan also highlighted in his lecture that the main points presented and possible follow up actions suggested requiring policy decisions from the Government may be brought to the notice of the concerned ministry. Prof. Shankar Ram was the moderator of the webinar. He collated the questions raised by the audience and presented them to the speaker at the end of the talk. The Q & A session was very interesting and interactive. Finally, Prof. Nandita DasGupta proposed the vote of thanks.

Lecture by Mr Bharati Raja, Interdisciplinary Research Scholar, Department of Electrical Engineering, IIT Madras on "Hydrogen Production through methane pyrolysis: An alternate approach to zero carbon emission" was organized on 13th April 2022 jointly by INAE Chennai Chapter, IEEE Madras Section and IIT Madras. Name of the Speaker: Mr. Bharathi Raja, Research Scholar (Winner Prize in New generation ideation contest 2021 organized by Hindustan Petroleum Green R&D centre, Bangalore.)

National Conference on Energy Technologies (NCET-2022)

Indian National Academy of Engineering (INAE), **Chennai Chapter** along with Indian Institute of Technology Madras partnered with International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Chennai to organize the **National Conference on Energy Technologies (NCET-2022)** on 29th and 30th April 2022. The Conference brought together leading academic scientists, researchers, scholars and industry experts to exchange experiences and research results on all aspects of energy storage systems and technologies including battery, fuel cells, supercapacitors, solar and wind energy.

Delivering the Special Remarks virtually, Dr. Anil Kakodkar, Former Chairman, Atomic Energy Commission of India, spoke about the way forward for energy transition of India from fossil fuels to net-zero. He stressed the role of hydrogen energy and the need for the direct splitting of water into hydrogen through grid-independent systems. He also emphasized the need for 'made in India' solutions to overcome the net-zero target. Addressing the Conference, Prof. V. Kamakoti, Director, IIT Madras, highlighted the need for Grid Security and Data Protection. He stressed the need for energy auditing to save power. He also mentioned the interesting solutions provided by the start-ups and their need in realising the net-zero *Atmanirbhar Bharat.*

Delivering the keynote address, Prof. Ashok Jhunjunwala, President, IIT Madras Incubation Cell (IITMIC) and IIT Madras Research Park (IITMRP), presented his analysis on 'How Soon can India get to Net-Zero.' He pointed out that the developed countries contribute most to global warming, while India was placed at 103rd in Greenhouse Gas Emissions (GHG). The need for strategies in green technologies with commercial viability supported by exclusive policy intervention was strongly proposed in his talk. Prof. Ashok Jhunjhunwala highlighted the challenges in energy storage even during the availability of abundant solar energy. He gave an overview of calculating the cost per kWh taking into consideration the depreciation and the interest involved.

The topics that were discussed during the two-day National conference include

- Energy Storage Technologies for EVs, stationary applications and strategic sectors
- Hydrogen and Fuel Cell technologies
- Material selection and design for Energy Storage and Conversion
- Process technologies for Recycling and Waste management
- Energy Demand Analysis in Smart Grids and other sectors
- Data Analytics for Renewable Energy Integration
- Artificial Intelligence Applications to Energy storage devices

Prof. Indranil Manna, President, INAE in his speech, emphasized reaching the net-zero energy infrastructure without jeopardizing nature. Prof. Sundararajan, former director of International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), stressed the need for topic-specific meetings within India to quickly achieve disruptive technologies. Prof. Narayanan, INAE President-Chennai Chapter, briefed about the various activities happening at INAE Madras Section which are of national interest. He emphasized the importance of micro-scale energy harvesting such as through vibrations.

Dr. R. Gopalan, Regional Director of ARCI, Chennai Centre, and Prof. R. Sarathi Department of Electrical Engineering made the welcoming remarks, highlighting the focus of the conference. They emphasized the importance of interdisciplinary research in realizing green technologies.

As many as 14 eminent scientists/academics/industry experts delivered lectures during the conference covering the spectrum of energy technologies along with 36 oral presentations by researchers. Four best oral presenters were awarded certificates and prizes. The Two days event ended with a vote of thanks

by Prof. Nandita DasGupta, Secretary INAE Chennai Chapter. She concluded the event by stating that it was brainstorming with young minds and researchers working on energy technologies and would form a pathway to achieving Net-Zero.

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. A report on the webinar by INAE Delhi Chapter can be viewed by clicking here….

The Chapter also organized a Technical Talk on **"Artificial Intelligence: Past, Present & Future"** by **Professor Dr Mausam**, Founding Head of School of Artificial Intelligence and Professor of Computer Science at Indian Institute of Technology (IIT) Delhi held on **Monday, 30th May 2022 at 4 PM** at **Indian Institute of Technology (IIT) Delhi** in a hybrid mode.

INAE Mumbai Chapter

Annual General Meeting of INAE Mumbai Chapter was held virtually on 19th February 2022. The agenda was as follows:

1. Talk on "Why is "Urban Air Pollution" a Regional Misnomer: The India narrative" by Prof. Chandra Venkataraman, IIT Bombay, Shobha Dixit Chair Professor in the Interdisciplinary Programme in Climate Studies and the Department of Chemical Engineering at the Indian Institute of Technology Bombay
2. Review of activities of the Chapter: Dr. Saswati Roy, Secretary - INAE Mumbai Chapter
3. Statement of accounts: Prof. S.V. Kulkarni, Institute Chair Professor, IIT Bombay, Treasurer - INAE Mumbai Chapter
4. Selection of new Executive Committee for three years

Prof. AK Suresh, FNAE began the proceedings with a segment in memory of Prof. Rajinder Kumar, Padma Bhushan awardee and a retired faculty member of the Department of Chemical Engineering at Indian Institute of Science, Bangalore who passed away on Monday, 7 February 2022. A short message on the life and many contributions of Prof Kumar was read out, and as a mark of respect to the departed soul, a minute's silence was observed.

This was followed by the presentation on "Why is "Urban Air Pollution" a Regional Misnomer: The India narrative" by Prof. Chandra Venkataraman. Prof. AK Suresh, Department of Chemical Engineering, IIT Bombay, acted as Moderator for the session.

A BRIEF SUMMARY OF TALK

India currently experiences severely degraded air quality, while future economic development will further increase challenges for air quality management. The National Clean Air Programme (NCAP) proposed a laudable and ambitious goal of reducing ambient PM-2.5 concentrations (particulate mass in particles smaller than 2.5 μm aerodynamic diameter) by 20-30% by 2024, over 2017 levels. This target is set for over two hundred cities in non-attainment of the national ambient air quality standards (NAAQS). Strategies for effective mitigation of air pollution require strong scientific underpinning. With this general backdrop, Prof Chandra described the evidence built using multiple modelling methods, integrated with observations. The questions tackled included those on sources which most strongly influence air pollution, regional transport of emissions across parts of India, spatial distribution of population impacts and, importantly, how climate change might affect air pollution levels. An

important development to address such questions is that of an emissions inventory, the **S**peciated **M**ulti-p**o**llutant **G**enerator (SMoG-India). Prof Chandra also described optimized modelling platforms, like the WRF-Chem RCM and ECHAM6-HAM2 GCM for aerosol simulations to accurately capture mesoscale meteorology, dust transport and deposition, the aerosol lifecycle, photochemistry and secondary aerosol formation. A particular focus of the talk was the regional dominance of non-formal sources (including residential-biomass cooking, agricultural stubble burning and fired brick production), which are dispersed and discontinuous in nature. The influence of long-range transported pollutants, not just local sources, was demonstrated; this requires assessment and intervention measures on regional scales (state and district), rather than on urban scales, being undertaken in the NCAP. Prof Chandra discussed the recent research findings from her group, which indicate that radiative feedback to meteorology, which increases with climate change, could worsen air pollution levels. Thus, the disproportionate impacts of air pollution mortality and morbidity on non-urban citizens was highlighted. The talk concluded with suggestions on the priorities to address the complexity of an effective portfolio of mitigation solutions.

Brief biodata of Prof. Chandra Venkataraman

Chandra Venkataraman is the Shobha Dixit Chair Professor in the Interdisciplinary Programme in Climate Studies and the Department of Chemical Engineering at the Indian Institute of Technology Bombay. Her research focuses on the intersection of technology and emissions, aerosol science and engineering and environmental sustainability policy. She has worked widely on-air pollution, climate change and nanoparticle aerosol drug delivery. Prof. Venkataraman was the Founding Convener of the Interdisciplinary Programme in Climate Studies (2012-2018), a first such doctoral programme in India. She is the National Coordinator of the 22-institution COALESCE network (Carbonaceous Aerosol Emissions, Source Apportionment and Climate Impacts) of the MoEFCC towards understanding the regional carbonaceous aerosol life cycle, climate impacts and climate feedback to air quality. She has mentored women STEM faculty and worked to address institutional systems that could support their advancement. Prof. Venkataraman's research has contributed over 100 journal publications, a book and four patents. She is a committed research mentor, with former students in academic and R&D positions worldwide. She has been recognized through a Fulbright-Nehru Fellowship (2012), the PRL Vikram Sarabhai (2005) and IGBP-START (1998) awards, citation database listing among top-2% Indian scientists in Atmospheric & Climate Science (2020) and has been elected to the INAE (2016), NASI (2017), IASc (2018) and INSA (2022).

INAE Mumbai Local Chapter also organized a lecture by **Prof. Atul Sharma**, Professor, Mechanical Department, IIT Bombay on **17th May 2022** in a hybrid mode. The title of the said lecture was **"Computational Fluid Dynamics for Academia and Industries".**

REPORT OF THE LECTURE ORGANIZED BY INAE MUMBAI CHAPTER ON "COMPUTATIONAL FLUID DYNAMICS FOR ACADEMIA AND INDUSTRIES"

The INAE Mumbai Chapter organized first lecture of the lecture series at BARC Mumbai on 17th May 2022. The programme of the lecture started with a one-hour interaction with the students (M.Tech/PhDs) of Homi Bhabha National Institute (HBNI) Mumbai, which was moderated by Dr RB Grover, FNAE, Emeritus Professor HBNI; Dr R. K. Singh, FNAE, Co-convenor INAE Mumbai Chapter and Senior Professor HBNI; and Dr. Archana Sharma, FNAE, Secretary INAE Mumbai Chapter and Outstanding Scientist BARC. The interaction session was followed by a lecture on "Computational Fluid Dynamics (CFD) for Academia and Industries" by Dr Atul Sharma, FNAE, Professor IIT Bombay. The lecture was delivered on a hybrid-mode, which was attended in-person by the scientists of BARC and students of HBNI; and also, by the online participants via INAE platform. The lecture began with a welcome address by Dr R. K. Singh followed by introduction of the speaker by Dr. S. V. Kulkarni, FNAE, Co-convenor INAE Mumbai Chapter and Professor IIT Bombay.

Prof. Sharma demonstrated CFD as a powerful tool for physics-based simulations and big-data analysis of various fluid flow and heat transfer problems in academic as well as industrial research and development. For academic research, he presented a *physical law-based* finite volume method (FVM) on CFD development while CFD application and analysis are presented for two types of problems: first, four different studies on various types of fish-like *unified-kinematics*, *adaptive-kinematics, continuous-vs-intermittent swimming*, and *batoid fish-like swimming* of a 2D and 3D hydrofoil; and second, *flow induced coupled-vibrations* of an elastically-mounted cylinder and a detached flexible plate. Further, CFD application and analysis for industrial applications are presented for thermal-hydraulic characteristics and performance of two engineering systems: first, horizontal versus vertical fan-flow across a radiator in a *power transformer*; and second, three different studies on 3D *printed circuit heat exchanger* (PCHE)—used as a recuperator in International Thermonuclear experimental reactor (ITER). The seminar was covered with numerous fluid-dynamic movies for the above problems in academia and industries.

In questionnaire session, the participants discussed on few pertinent aspects of CFD development, application, and analysis such as relevance of physical law based FVM, flow physics for the flow-induced vibrations, and the bonding of the plates in the PCHE. The Secretary, INAE Mumbai Chapter, thanked the speaker for his outstanding lecture, participants, organizing team at HBNI, and INAE team for the support and making this event successful.

INAE Bhubaneswar Chapter

Distinguished Lecture Series: INAE Bhubaneswar Chapter has initiated a series of distinguished Lectures with support of SOA University and IMMT Bhubaneswar. These Lectures are given by the distinguished academicians, researchers and industry experts. They are targeted to the faculty, senior students, researchers and professionals of the region and the follows, young engineers and associates of the academy. They are expected to motivate and energize them to do research and innovations. The INAE Bhubaneswar Chapter initially plans to have one Lecture per month. It may be increased to two lectures per month. The series was inaugurated by the President of INAE**, Prof Indranil Manna.**

The **1st Lecture** of the Distinguished Lecture Series was delivered by Prof. Indranil Manna, President, INAE and Vice Chancellor, BIT, Mesra on December 7, 2021on the topic **"Science-Engineering-Technology: Synergy for Sustainable Growth"**. 306 attendees participated in the lecture.

Key Points : Innovation -A simplistic View , Global Innovation Index(GII) of India, SET[Science-Engineering -Technology]: Path to prosperity, Innovation Eco-Systems, Financial cycles of a startup's journey: Early seed, valley of death, survivability threshold, Money, Sustainability : A composite concept, United Nations sustainable development goals, Technology Vision 2020 VS Technology Vision 2035, Impacting Research Innovation and Technology, Synergy with National Missions, Innovation in advance ceramic and speciality glass at CSIR-CGCRI – Kolkata, Er Doped fibre amplifier, FBG based sensor for structural health monitoring, Societal impact of CSIR developed ceramic hip prosthesis, Translational Research is important.

Link of the you Video: https://youtu.be/EArktQeYQpg
People Participated: 306

The **2nd Lecture** of the Distinguished Lecture Series was organized by INAE Bhubaneswar Chapter jointly organized with SOA University and IMMT Bhubaneswar on 7th January 2022 by **Prof. Suman Chakraborty**, Institute Chair Professor & Sir J C Bose National Fellow, Professor in the Mechanical

Engineering Dept. of the Indian Institute of Technology Kharagpur on "**Democratized Diagnostic Technologies towards Affordable Healthcare for the Underserved**". 204 attendees participated in the Lecture.

Key Points: Health Care Delivery for Underserved, Towards Disruptive Innovations in Diagnostic Technologies, Diagnosis with One Drop of Body Fluid at The Point-Of-Care., Printed Paper Strip for Disease Detection, Testing Blood on A Potable Spinning Disc, Plasma Glucose Detection on A Printed Paper Strip, Evaluating Antibiotic Resistance, COVIRAP: Nucleic Acid Testing in Point-of-Care format, Low-Cost Potable Imaging Device for Early Screening of Oral Cancer, Convergence With Rural Livelihood.

Link to the Video: https://youtu.be/hW_VLs45JkM

People Participated: 200

The **3rd Lecture** of the Distinguished Lecture Series was organized by INAE Bhubaneswar Chapter, SOA University and IMMT Bhubaneswar on 7th February 2022. The topic of the Lecture was "**Revenge of Silicon- tracing the trends in computing and communication and how the machines mimic man"** and was delivered by **Prof N Balakrishnan**, Indian aerospace and computer scientist. He is a Professor of the Department of Aerospace Engineering and Supercomputer Education Research Centre of Indian Institute of Science, Bangalore. Highlights of the 3rd lecture can be viewed by clicking here ….

Key Points: ICT is the technology for the society. It will draw upon the advances in all branches of Science and Engineering and will seamlessly merge with them. It will become more dependent on the advances in Social Sciences, Nano sciences and Biological Sciences. When it merges with society and biology, it will become as complex as the God Made systems. The today's world would merge symbiotically. Silicon will slowly and steadily replace at least functionally the Carbon- it is the Revenge of Silicon! , Security in Socio- Technical world is very complex., When Silicon replaces carbon, the future ICT devices will make you 100 to 1000 times more efficient than you are today. , The future computers will do more than computing – tend to look more and more like Humans- from calculating Engines, to Thinking Machines to Spiritual Machines ! Larger memories AI make it more like humans- add Exploitability to AI. , Quantitative Differential equation based models to Machine learning from Instances – Date Centric Supercomputing Big Date Big Science., Your computer would start to look more and more like a human- you tend to build relationship with your computer, Seamlessly move between the you in the Physical Would and the You in the Cyber Would , Digital Physics going to lands of discovery where there are no 'lows but only lemma like in Computer Science.

Link to the Video: https://youtu.be/PQlYu6H2md8

People Participated: 150

The **4th Lecture** of the Distinguished Lecture Series Organized by INAE Bhubaneswar Chapter, SOA University and IMMT Bhubaneswar on 7th March 2022. The title of the lecture is **India's Self Sufficiency in Materials of 21st Century** and the Speaker was **Dr Debashish Bhattacharjee**, Vice President Technology and New Materials Business. Highlights of the 4th lecture can be viewed by clicking here ….

Key Points:

- Policy framework to be created to promote market for advance materials
- India should see itself as a manufacturing hub for the entire world market

- Encourage through funding collaborative technology development between industry, government, academia and MSME
- Ensure academic research supports technology development in new materials
- Design thinking for sustainable use of materials
- Need for independence in strategic materials
- Driven by aerospace, wind energy, sports, automotive
- As volume grows, cost will decrease
- Future of Graphene
- Titanium- an opportunity waiting

Link to the Video: https://youtu.be/bMXNaPXERjU

People Participated: 100

The **5th Lecture** of the Distinguished Lecture Series was Organized by INAE Bhubaneswar Chapter, SOA University and IMMT Bhubaneswar on **"Achieving Sustainability and Net Zero Mandate through Adoption of Hydrogen Economy, CO_2 Refineries & Biomass Conversion" by Prof Ganapati D. Yadav** on 8th March 2022. Highlights of the 5th lecture can be viewed by clicking here ….

Key Points:

- Energy, Environment and Climate Change. Energy and environment are intimately connected. More energy, more environmental damage, The climate change is due to the overuse of fossil fuels leading to emissions of CO_2 which is currently at 419.2 ppm. The energy needs of the world are increasing day by day and use of carbon-based fuels will continue to rise. Jan. 2020; 410 ppm, Jan. 2021: 412 ppm (Slowdown in economy) In order to meet the requirements of international treaties, the use of renewable resource is advanced.

- **Carbon based fuel and H_2 as Saviour**
  Whether the carbon is coming from, fossil fuels or biofuels there is a need to cover CO_2into fuels, chemicals and materials. Hydrogen is the cleanest fuel which can be produced from hydrarbons or from water and can be used to convert co_2into useful products. And treatment of (waste) biomass into hydrocarbons with the help of novel catalysts. Hydrocarbons can also be reformed into hydrogen, but CO_2needs to be utilized.
  Hydrogen will be the SAVOUR for the planet EARTH.

  Link to the Video: https://youtu.be/ve-l_rOdTfk

  People Participated: 130

Sixth Lecture Distinguished Lecture Series Jointly Organised by INAE Bhubaneswar Chapter, SOA University and IMMT, Bhubaneswar

INAE, Bhubaneswar Chapter, jointly with SOA University and IMMT Bhubaneswar organized a Distinguished Lecture series in virtual mode. The lectures of the series are given by eminent Engineers/Scientists/Technologists from India and abroad for the benefits of the students/faculty/ researchers/scientist/technologists of Colleges/ Universities/ Institutes. The **6th lecture** of this series was given by **Dr. Prasant Mohapatra**, Professor, Department of Computer Science and Vice Chancellor for Research at University of California, Davis on April 05, 2022 on "**Vulnerabilities in Federated Learning Networks**".

Key Points:
With more regulations tackling the protection of users' privacy-sensitive data in recent years, access to such data has become increasingly restricted. A new decentralized training paradigm, known as Federated Learning (FL), enables multiple clients located at different geographical locations to learn a machine learning model collaboratively without sharing their data. While FL has recently emerged as a promising solution to preserve users' privacy, this new paradigm's potential security implications may hinder its widespread adoption. The existing FL protocols exhibit new unique vulnerabilities that adversaries can exploit to compromise the trained model. FL is often preferred in learning environments where security and privacy are the key concerns. Therefore, it is crucial to raise awareness of the consequences resulting from the new threats to FL systems. To date, the security of traditional machine learning systems has been widely examined. However, many open challenges and complex questions are still surrounding FL security. In his talk, he provided an overview of the unique security vulnerabilities exposed by the FL networks. He highlighted the vulnerabilities sources, key attacks on FL, defenses, as well as their unique challenges, and discuss promising future research directions towards more robust FL.

Link to the Video: https://youtu.be/C3z4ZO3y1zs

People Participated: 135

The 7th Lecture organized by INAE Bhubaneswar Chapter, SOA University and IMMT Bhubaneswar on **"Hydrodynamics of sediment transport: grain scale to continuum scale"**. was delivered by **Prof. Subhasish Dey**, Professor, Department of Civil Engineering, Indian Institute of Technology (IIT) Kharagpur on April 07, 2022.

Key Points:
A theory of sediment transport, describing the entrainment phenomenon from the grain scale to the continuum scale, under a steady-uniform flow over a sediment bed is presented. The sediment grains, assumed as discrete spherical grains, are subjected to turbulent wall-shear flows. At the grain scale, the forces acting on a sediment grain resting over three compact spherical grains are analysed to determine the criteria for entrainment threshold in rolling, sliding and lifting modes taking into account the turbulence effects. Comparison of the theoretical results with the experimental data shows that the entrainment threshold lies within the sliding and lifting modes. Then, at the grain scale, using the log-normal probability density function for the near-bed instantaneous horizontal velocity, the entrainment probabilities in rolling, sliding and lifting modes for a given grain size are derived. The rolling and sliding probabilities increase with an increase in Shields function and after attaining their individual maximum values, they reduce, while the lifting probability increases with Shields function. The maximum value of entrainment probability in rolling mode is close to the threshold Shields function in rough flow, while the entrainment probability in lifting mode initiates from the value of the threshold Shields function. In a continuum scale, the bedload flux is derived by hypothesising the saltating mode of sediment transport incorporating the lifting probability obtained at the grain scale.

Link to the Video: https://youtu.be/oqoXjHqCXMo

People Participated: 130

The 8th Lecture of the Distinguished Lecture Series was organised by INAE Bhubaneswar Chapter, jointly with SOA University and IMMT Bhubaneswar on "**Natural materials for noise control of home appliances and automobile**" delivered on 5th May 2022 by Prof. Amiya Ranjan Mohanty, Professor & Head, Mechanical Engineering Department, Indian Institute of Technology, Kharagpur.

Key Points:
Traditionally, synthetic acoustic materials have been used for noise control, but they are costly and hazardous to environment. A recent trend is a shift towards natural fiber porous materials as these are low-cost, biodegradable and recyclable. This talk presents the effect of pre-treatment procedures on the acoustic, thermal and physical properties of a natural material, jute and composites made of jute. It is found that jute fibers and jute composites have high transmission loss, high sound absorption coefficient, low flammability, low density and high thermal stability. Thus, they are an excellent choice for industrial noise control. This talk would also present some case studies of jute-based noise control in household appliances, like refrigerators, domestic clothes dryer, vacuum cleaners, mixer grinders and automotive HVAC systems. In every case study, jute composites, applied as sound absorbers and sound barriers, are able to significantly reduce the noise level by 4 dB or more, and improve the sound quality of the product. Therefore, jute composites have high potential as low-cost, light weight, sustainable materials for industrial noise control.

Link to the Video: https://youtu.be/58DE2RcS0wA

People Participated: 97

Bio of Speaker:
Prof. Amiya Ranjan Mohanty received the B.Sc. Engg. (Hons.) degree in mechanical engineering from the National Institute of Technology, Rourkela, in 1986, and M.Tech. degree in the area of machine design from the Indian Institute of Technology (IIT), Kharagpur, India, in 1988. He received his Ph.D. degree in the area of noise control from the University of Kentucky, Lexington, USA in 1993. He was with the Ray W. Herrick Laboratories, School of Mechanical Engineering, Purdue University, West Lafayette, USA, as a Postdoctoral Fellow, working in the area of active noise control. His research interests are in the areas of machinery condition monitoring, underwater acoustics, signal processing, acoustics and noise control.

Presently, he is a Professor and Head of the Department of Mechanical Engineering at IIT Kharagpur, India. He has worked in the R&D Division of Larsen and Toubro Ltd., Mumbai, India, in the area of machinery condition monitoring. He has also worked in Ford Motor Company, Detroit, USA, in the area of automobile Computer Aided Engineering/Noise Vibration & Harshness (CAE/NVH). His over 25 sponsored research projects and more than 100 consulting projects in the areas of noise control and machinery condition monitoring are funded by many government agencies and industries. He has more than 150 journal and conference publications, four book chapters and one book on "Machinery Condition Monitoring: Principles and Practices", CRC Press, (2014), to his credit.

Prof. Mohanty held the Shyamal Ghosh and Sunanda Ghosh Chair Professor position at IIT Kharagpur. He is an elected fellow of the Indian National Academy of Engineering, Acoustical Society of India, Condition Monitoring Society of India, International Society of Engineering Asset Management, Institution of Engineers (India). He has received several awards like the Chancellor's Award for Outstanding Teaching at the University of Kentucky (1993), Rais Ahmed Memorial (2009) and M. S. Narayanan Memorial (2015) Award of the Acoustical Society of India, Star Alumnus Award of NIT Rourkela (2015), Dr. V. Bhujanga Rao Endowment Lecture Award (2019) of the Condition Monitoring Society of India. He is also the recipient of the Overseas Academic Programme (OAP)-inbound fellowship of the National University of Singapore. Prof. Mohanty was selected as a participant in the LEAP programme of the MHRD at Cambridge University, UK in 2019.

The **9th Lecture** of the Distinguished Lecture Series organised by INAE Bhubaneswar Chapter, jointly with SOA University and IMMT Bhubaneswar on "Si Photonics systems as interconnects in current

data centres" delivered on 7th May 2022 by Prof. Prasanta Kumar Basu, Retired Professor, Institute of Radio Physics and Electronics, University of Calcutta.

Key Points:
The copper or aluminium interconnects used in VLSI/ULSI circuits cannot be scaled down in the same ratio as the individual transistors are done. The RLC elements of metal limit severely the data rate and at the same time contribute to power dissipation. Optical interconnects now replace metal interconnects by offering ultrahigh bandwidth, low power dissipation, freedom from insulation and fast processing speed. High data rate communication systems based on Silicon Photonics (SiPh) chips and optical fibre or waveguides connects different elements in servers and high-performance computers in current data centres. The short distance communication systems work at the board-to-board, node-to-node and even chip-to-chip levels. All elements in the system, modulators, detectors, mux/demux, waveguides and processing electronics excepting the laser, are integrated on Si platform by using standard CMOS processing technology.

The talk covered the basic of optical communication, devices used, interconnect bottleneck and the solution in terms of photonics SiPh. R&D work supported by government, academia, industries like Intel, TSMC, users like Facebook, Google etc, new vendors, and research groups in India were mentioned.

You tube Link to the Video: https://youtu.be/xUTiioi0R70

People Participated: 90

Biodata of Speaker
Prasanta Kumar Basu (*b*1946**)**, B.Sc. (Physics, Presidency College), B.Tech, M.Tech, and Ph.D., retired from RPE/CU in 2011, and then worked as UGC BSR Faculty Fellow, Visiting Professors at IIT KGP and National Chung Cheng University (NCCU), Taiwan, and thereafter as an Investigator in an Indo-Taiwan project. In his long career as teacher, researcher, and administrator, he had nearly 140 journal papers, 4 books and 2 book chapters all from international publishing houses, and he guided and is still guiding more than 20Ph.D. students. He initiated an international conference series *CODEC* and earned for the department the title *UGC Networking Resource Centre inPhysical Sciences*: the first in India. He worked as a post doc in Belgium, Alexander von Humboldt fellow in Germany, first INSA Research fellow, visiting professors in TIFR, McMaster University, Canada, NCCU and INSA-Royal Society Exchange professor in UK. He also served for 8 years as a member of EPSRC College, UK, to review their projects. Currently, he is engaged in joint research and book writing with faculties of RPE, NIT Delhi, McMaster University and NCCU- Taiwan.

Technology Day Lecture of the Distinguished Lecture Series was organised by INAE Bhubaneswar Chapter, jointly with SOA University and IMMT Bhubaneswar on "**Climate Change, Extreme Weather Events and Technological Intervention for Sustainable Development**" delivered on 11th May 2022 by Prof. Uma Charan Mohanty, School of Earth, Ocean and Climate Sciences (SEOCS), IIT Bhubaneswar, Argul, Khurda, Odisha.

Forthcoming Events

The Symposium on National Frontiers of Engineering (NatFOE) is one of the flagship events of INAE since 2006. The main objective of the event is to encourage Young Engineers (ages ~27-45) from industry, universities, and R&D labs to discuss leading-edge research and technical work across a range of engineering fields. This year the 16th symposium on NatFoE (NatFOE-2022) will be organized by INAE jointly with Jadavpur University, Kolkata, in collaboration with IIT Kharagpur during June 18-19, 2022 at Jadavpur University, Kolkata. The symposium will provide a platform for the invited

speakers and participants to exchange ideas – through the designated presentations, posters or even through across-the-table discussions – and identify niche areas for collaborative research and development on complementary domains of expertise.

NatFOE-2022 will be followed by a one-day National Competition on Innovation in Manufacturing Practices (IMP 2022) at Jadavpur University, Kolkata on June 20, 2022 to provide a platform for engineering students and practitioners to compete in an All India Contest to showcase innovations in manufacturing sector. Undergraduate, post graduate and entrepreneurs (start-ups) have been invited to submit their entries in various fields of engineering which will be evaluated by eminent Jury to announce six final prizes, two in each category.

To view details of **NatFOE-2022 to be held on June 18-19, 2022** and **IMP 2022 to be held on June 20, 2022** at Jadavpur University, Kolkata, please visit the event website https://www.natfoe-imp2022.com/index.html. A Brochure of IMP can be viewed by clicking here….

The event can be viewed live and the link for live streaming of the NatFoE and IMP events to be held at Jadavpur University are given below.

YouTube channel name: NatFoE-2022

Channel URL :- https://www.youtube.com/channel/UCzMtf1f4MYJl-UkVHsLV7OA

NatFoE-IMP Scheduled :-

NatFoE Day – 1- Jun-18-2022 https://youtu.be/mTN28q-uDkw

NatFoE Day – 2 -Jun -19-2022 https://youtu.be/BhOZuXN-seo

IMP Day – 3 - Jun-20-2022 https://youtu.be/DcAMIiC_SY0

Academia Industry Interaction

AICTE-INAE Distinguished Visiting Professorship Scheme

Industry-academia interactions have become essential with world-over technological changes in recent times. The interactions can impart relevant knowledge to the students in the engineering institutions, which is sustainable in the changing conditions. The exchange of knowledge proves to be beneficial for both academic institutions and industries. While industries could use the Academia's knowledge base to improve the industry's internal R&D, quality and global competitive dimensions, academicians benefit from gaining knowledge about dynamics of Industrial real time situations, identifying problems for improved research and using their knowledge and expertise to find practical solution and 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 lectures in engineering institutions. This scheme is popular among industry experts as well as engineering colleges.

Due to prevalence of Covid pandemic, the scheme was operated on the modified Standard Operating Procedure (SOP) allowing existing DVPs conduct online. Existing 54 DVPs conducted classes with

their respective associated colleges. With the travel restriction being removed, some of the DVP s started travelling to campus of their associated engineering colleges and giving lectures in person.

INAE received 58 fresh nominations of Industry / R&D experts in response to advertisement published by AICTE for academic year 2021-22. A meeting of AICTE-INAE Distinguished Visiting Professorship Scheme Committee was scheduled on March 28, 2022. AICTE on March 13, 2022 informed INAE that due to internal policy decision, it was decided that no financial support will be provided to INAE for the scheme during FY 2022-23. The scheme has been withheld with effect from April 1, 2022.

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

Dr. Rabindra Nath Ghosh, FNAE Chair Professor, Metallurgical & Materials Engineering Dept., IIT, Kharagpur	College of Engineering, Pune May 16-19, 2021 Nov 29, Dec 24 & 31, 2021	Delivered lectures on "Failure analysis, why & how components fail", "Failure mechanism & its characteristic signature" and "Metallurgical failures: case studies". As per the feedback received from the engineering college, the lectures by Prof. Ghosh were extremely useful to understand the subject of failure analysis. Delivered lectures on "Non-destructive testing & evaluation", "Visual testing, Liquid penetrant test, Magnetic particle testing" and "Eddy current test, Radiography, Ultrasonic testing". As per the feedback from the faculty coordinator the topics covered in the lectures shall help students to choose most suitable testing methods for such components.
Dr. Hasan Shaikh Formerly Scientist / H (IGCAR)	Viswajyothi College of Engineering & Technology, Kerala Dec 1-3, 2021	Delivered lectures on "Welding Metallurgy of Steel and Stainless Steel", "Overview of Environmental Degradation of welds and Corrosion", "Projects". As per the feedback received from the engineering college, the scheme provides a platform to interact with Industry Expert. The DVP helped in identifying projects by discussion on new technologies and development related to Additive Manufacturing.
Dr. Ashok Kumar Tripathy, FNAE DG CPRI and Sr. Prof and Advisor, SIT	Silicone Institute of Technology, Bhubaneswar Dec 28, 2021	Delivered lectures on "A Career in Industry for electrical and Electronic students", "Research areas in Electrical and Electronics". As per the feedback received from the engineering college, the lecture on power system and the guidance on career have been quite beneficial for post graduate students.
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 Feb 22 $& 25, 2022	Delivered lectures on "Energy Storage Devices: Solar Cells" and "Advances in Nanotechnology". As per the feedback received from the faculty coordinator, the sessions have been very engrossing for BTech Students, Research Scholars and faculty members of the department.

Dr. Hasan Shaikh Formerly Scientist H (IGCAR)	Viswajyothi College of Engineering & Technology, Kerala Feb 17-19, 2022	Delivered lectures on "Welding Metallurgy of Austentic Stainless Steel" and "Corrosion of Welded Joints". As per the feedback received from the engineering college, the DVP has guided three projects and conducted Group discussion on Research and Projects. The interactions with Dr. Shaikh have helped students and faculty members immensely to gain confidence in doing research.
Mr. Ajay Narayan Deshpande, FNAE Ex CMD & Director (Technical), Engineers India Limited	Manipal University, Jaipur Feb 17, 24, 2022 & Mar 10, 2022	Delivered lectures on "Petrochemical Products, Process Technology, Plant Design features, Commercial References-OLEFIN & Derivatives", " Petrochemical Products, Process Technology, Plant Design features, Commercial References-AROMATIC & Derivatives" and "Growth potential for manufacturing capacity of Petrochemicals; Integration aspects of Refinery and Petrochemical Complexes". As per the feedback received from the engineering college the DVP was a part of the curriculum development in BTech (Hons) program in Petroleum Engineering. the scheme has added value in terms of course development, lectures based on industrial perspective making students industry aware and ready.
Prof. Rajendra Prasad Chhabra, FNAE Retired Professor, IIT Kanpur, Mentor and Visiting Professor, IIT Ropar	Shaheed Bhagat Singh State Technical Campus, Punjab Apr 20-22, 2022	Delivered lectures on "Soft Matter and Non-Newtonian Behaviour- Part I", Soft Matter and Non-Newtonian Behaviour- Part II" and Soft Matter and Non-Newtonian Behaviour- Part III". As per the feedback received from the college, more such lectures are required, and classes have been scheduled in May 2022.
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 Apr 18-20, 2022 Government College of Engineering, Salem	Delivered lectures on "Fundamentals of dislocation behaviour and strengthening mechanisms", "Creep, creep testing, mechanism of creep, deformation maps, grain boundary sliding and creep fracture" and "Creep data extrapolation, design and selection of high temperature materials, steels and super alloys, creep designing". As per the feedback received from the engineering college, the interactions were very useful for the students regarding the related topics of creep testing. More interactions are desired in future. Delivered lectures on "Fundamentals of dislocation behaviour and strengthening mechanisms", "Creep Deformation, Creep and Stress rupture testing, Creep Mechanisms- Dislocation Creep and Diffusional Creep", ' Deformation Mechanisms

	Apr 11-13, 2022	Maps, Creep fracture, Time-Temperature parameters, Selection of materials for high temperature service". As per the feedback received from the engineering college, the interactions with the DVP were quite intense and benefitting. Both students and faculty members would like such interactive classes in future in the thrust areas.
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 Apr 4-7, 2022 Apr 11, 13 & 18, 2022	Delivered lectures on "Advanced biofuel production processes using renewable resources", "Fundamentals and technology advances of biohydrogen production processes" and "Effect of bioreactor configurations on the biofuel production". As per the feedback received from the college, the lectures have been pertaining to the course of BTech and MTech and have been beneficial for the students. Delivered lectures on "Thermodynamics and Kinetics of Biomethanation process", "Biohythane: fuel for the future" and "Scale-up and Case studies of biofuels production processes". As per the feedback received from the college, the interactive session with faculty members and the students have been highly beneficial for research activities of the department.
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 Apr 7-8, 2022	Delivered lectures on " Introduction to mathematical modelling and Simulation in Engineering", "Discussion on E&TC curriculum of batch 2022-26" and "Why and How to do research in an academic institution?". As per the feedback received from the engineering college, the scheme provides a platform to interact with young minds and gave an opportunity to discuss student projects which helped them modify/extend their projects. The scheme helps to establish linkages between industry and engineering institutions which can help to enrich the curriculum.
Dr. Rabindra Nath Ghosh, FNAE Chair Professor, Metallurgical & Materials Engineering Dept., IIT, Kharagpur	College of Engineering, Pune Mar 29, Apr 10 & 12, 2022 Mar 26, Apr 2 & 13, 2022	Delivered lectures on "NDT/ NDE/ NDI: basic concepts, VI, PT, MT", "Eddy current & ultrasonic tests, type of probes, test methods & its scope & limitation". As per the feedback received from the engineering college, the DVP helped in framing out the syllabus NDT course. Delivered lectures on "Failure analysis: Why components fail; how to find its cause", "Failure Mechanisms & characteristic signatures" and "Metallurgical failures: case studies". As per the

		feedback received from the college, the course on " Failure Analysis of Engineering Materials" has been introduced recently in college and the lectures offered by the DVP was extremely useful. More interactions are required.
Dr. Sreekumar Thaliyil Veedu Senior Consultant, Reliance Industries Ltd. (RIL)	DKTE Society's Textile & Engineering Institute, Ichalkaranji Mar 19, 2022	Delivered lectures on "Introduction to Synthetic Fibres Manufacturing". As per the feedback received from the engineering college, the lectures were highly beneficial for the students of Textile Department.
Mr. S. Krishna Kumar Former Senior Vice President (Retired), Lucas TVS Ltd, Chennai	RMK Engineering College, Kavaraipettai, Tamil Nadu Mar 7-9, 2022	Delivered lectures on "Optimised manufacturing system for the present Indian Automotive component industry", "Quality control story approach for problem solving in the manufacturing industry" and "Quality function deployment process in the new product development for manufacturing industry". The engineering college has informed that this scheme helps engineering colleges especially private ones to excel in their offering of in-depth knowledge based on the rich experience of Industry Experts.
Dr. K. C. Vora Sr. Deputy Director & Head, ARAI	G H Raisoni Institute of Engineering and Technology, Pune Feb 5 &19, 2022	Delivered lectures on "Indian Automotive Scenario & Homologation" and "Innovation, Research & Start-up Ecosystem". Feedback received from the faculty coordinator mentions that the scheme is excellent for interactions with industry people. This helps to generate industry contacts, enhance knowledge in advanced technology used in Industry.

Important Meetings held during February 2022, March 2022, April 2022 and May 2022

List of Meetings in May 2022

May 27	38th Apex Committee Meeting
May 21	First online meeting of the ES-X for Election of Fellows & Foreign Fellows and processing of INAE Young Engineer Award -Part II
May 20	Urgent Meeting of the Governing Council on 20th May 2022
May 18	INAE-NATF Workshop - Finalization of themes
May 18	First online meeting of the ES-X for Election of Fellows & Foreign Fellows and processing of INAE Young Engineer Award
May 18	Planning the conduct of 5th INAE-NAEK Workshop
May 17	Computational Fluid Dynamics for Academia and Industries

May 17	1st Meeting of the ES-I (Civil Engineering) for Election of Fellows & Foreign Fellows and processing of INAE Young Engineer Award
May 13	First online meeting of the Sectional Committee-III (Mechanical Engineering)
May 13	Meeting of INAE Forum on Technology Foresight and Management
May 11	First meeting of the ES-IX for Election of Fellows & Foreign Fellows and processing of INAE Young Engineer Award
May 10	Meeting of the ES-V for Election of Fellows & Foreign Fellows & INAE Young Engineer Award
May 10	1st Meeting of the Sectional Committee-II for Election of Fellows & Foreign Fellows and processing of INAE Young Engineer Award
May 9	1st Meeting of the ES-V for Election of Fellows & Foreign Fellows and processing of INAE Young Engineer Award
May 7	INAE Apex Committee Meeting
May 6	1st Meeting of the Sectional Committee-VII for Election of Fellows & Foreign Fellows and processing of INAE Young Engineer Award
May 6	1st Meeting of the Sectional Committee-VI for Election of Fellows & Foreign Fellows and processing of INAE Young Engineer Award
May 5	ISRO-INAE Consultative Committee Meeting
May 5	First meeting of the ES-IV for Election of Fellows & Foreign Fellows and processing of INAE Young Engineer Award
May 5	Meeting for Conduct of EC 2022
May 4	1st Meeting of Sectional Committee-VIII for Election of Fellows & Foreign Fellows and processing of INAE Young Engineer Award
May 4	Meeting of Sub Committee for Compendium on Landmark Achievements in Engineering and Technology in Independent India.
May 2	Meeting with Conveners of all Sectional Committees on May 2, 2022

List of Meetings in April 2022:

Apr 23	11th Meeting of Task Force on proposed Compendium on "Landmark Achievements in Engineering and Technology in Independent India"
Apr 22	Online Link for first Meeting of DAE-INAE Consultative Committee
Apr 19	Meeting of Sub-Committee on Proposed Compendium on "Landmark Achievements in Engineering and Technology in Independent India"
Apr 15	Thematic Satellite Discussion on Opportunities and Challenges of Implementation of National Education Policy (NEP) 2020
Apr 14	Discussion on Landmark Compendium
Apr 14	Thematic Satellite Discussion on "Opportunities and Challenges for Implementation of NEP 2020" - Administrative Aspects
Apr 14	Thematic Satellite Discussion on “Opportunities and Challenges for Implementation of NEP” - R&D and Industrial Aspects
Apr 13	Thematic Satellite Discussion on Opportunities and Challenges for Implementation of NEP 2020- Academic Aspects
Apr 11	Thematic Satellite Discussion on Opportunities and Challenges for Implementation of NEP 2020 - Teaching Aspects
Apr 11	Meeting between editors and INAE Representatives for Landmark Compendium
Apr 11	Discussion on Landmark Compendium
Apr 9	Meeting between editors and INAE Representatives for Landmark Compendium
Apr 8	Meeting between editor sand INAE Representatives for Landmark Compendium
Apr 7	Meeting between editors and INAE Representatives for Landmark Compendium
Apr 1	First meeting of the Core Committee for NATF activity

List of Meetings in March 2022:

Mar 25	142nd Governing Council Meeting on 25th March 2022
Mar 23	Meeting to discuss SERB Digital Gaming Initiative
Mar 21	Meeting for INAE Foundation Day 2022
Mar 15	Preliminary Meeting: First Meeting of DAE-INAE Consultative Committee
Mar 14	Annual Charter Guidelines for INAE Local Chapters and Ordinance on Memorial Lecture Series for deceased INAE eminent Fellows
Mar 11	33rd Finance Committee Meeting
Mar 9	Meeting of INAE Forum on Technology Foresight and Management for addressing National Challenges
Mar 8	Meeting on EC-2021: Recommendations Booklet
Mar 8	Meeting to discuss NATF collaboration
Mar 1	Meeting of Editorial Committee for Publication of Compendium on Women Engineers of India since Independence

List of Meetings in February 2022:

Feb 27	Meeting of Editorial Team for Proposed Compendium on "Landmark Achievements in Engineering and Technology in Independent India"
Feb 25	Steering Committee Meeting
Feb 24	Meeting of Sectional Committee-IX to brainstorm on indigenisation initiatives for promotion of Decentralized Renewable Energy
Feb 23	INAE Compendium on Landmark Achievements: Administrative Points of Editor
Feb 20	Meeting of Editorial Team for Landmark Compendium
Feb 19	Meeting with suggested Editors for Proposed Landmark Compendium
Feb 16	INAE-SERB Collaborative Initiative (*Atmanirbhar* Technologies & Hackathon)
Feb 16	INAE-SERB Collaborative Initiative in Engineering
Feb 16	SERB-INAE Women Engineers Program
Feb 16	INAE Digital Platform Committee Meeting
Feb 15	Steering Committee Meeting
Feb 15	Meeting of Taskforce for Landmark Compendium
Feb 5	Meeting Regarding Way Forward for Editor of Landmark Compendium
Feb 4	Meeting Regarding Transactions of INAE Journal March 2022 issue
Feb 1	37th Apex Committee Meeting

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

International Conference on Design and Engineering of Lighter-Than-Air systems (DELTAs - 2022) Conference; online and in-person on 22nd to 26th June 2022at Mumbai, Maharashtra
https://conferencealerts.com/show-event?id=239912

Fifth International Conference on Soft Computing and Signal Processing Conference; online and in-person on 24th to 25th June 2022 at Hyderabad, Telangana,
https://conferencealerts.com/show-event?id=242570

4th International Conference on Intelligent Computing, Information and Control Systems (ICICCS 2022) Conference; online and in-person at 29th to 30th June 2022 Tiruchirappalli, Tamil Nadu
https://conferencealerts.com/show-event?id=242413

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HONOURS AND AWARDS

1	The following INAE Fellows were elected as International Members of the NAE, USA in the year 2022. 1. Prof G Bhuvaneswari, FNAE, Professor, Mahindra University École Centrale School of Engineering, Hyderabad and formerly Professor, Department of Electrical and Electronics Engineering, Indian Institute of Technology, New Delhi elected for contributions to advancement of power converters to improve power quality, and leadership in using advanced technologies for education. 2. Mr N Chandrasekaran, FNAE, Chairman, Tata Sons Private Limited, Mumbai elected for changing the nature and advancing the capabilities of the software industry in India. 3. Dr RD Kulkarni, FNAE founder, Elkay Chemicals Private Limited, Pune elected for innovation-centric business and technology development and leadership across disciplines. 4. Dr BN Suresh, FNAE, Chancellor, Indian Institute of Space Science & Technology (IIST) & honorary distinguished professor, Indian Space Research Organization, Bengaluru elected for contributions to advances in technologies for space exploration and for leadership to promote peaceful uses of outer space. 5. Prof GD Yadav, FNAE, emeritus professor of eminence, Chemical Engineering, Institute of Chemical Technology, Mumbai elected for research, innovation, and education in green chemistry, catalysis, nanotechnology, and chemical engineering leading to clean and green technologies.
2	Prof GD Yadav, FNAE, emeritus professor of eminence, Chemical Engineering, Institute of Chemical Technology, Mumbai was selected as a National Science Chair, a scheme of Science and Engineering Research Board (SERB), DST New Delhi.
3	Prof BS Murty, FNAE, Director, IIT Hyderabad was conferred the "National Metallurgist Award 2021" on April 20, 2022 by the Hon'ble Minister of Steel at New Delhi. National Metallurgical Awards were instituted by Ministry of Steel to recognize outstanding contribution of metallurgical fraternity in Iron & Steel Sector covering the fields of manufacturing, Research & Development, academics etc.
4	Mr VN Heggade, FNAE, Chief Executive Officer (CEO), STUP Consultants Pvt. Ltd, Mumbai received the "OP Jain Memorial Structural Design Award – 2021 instituted by IIT Roorkee.
5	Prof Sudhir K Jain, FNAE, Vice – Chancellor, Banaras Hindu University, Varanasi and formerly Director and Professor of Civil Engineering, IIT Gandhinagar was conferred the Distinguished Alumni Award 2022 by California Institute of Technology, USA.
6	Prof Ranjan K. Mallik, FNAE, Institute Chair Professor and J. C. Bose Fellow Department of Electrical Engineering Indian Institute of Technology Delhi has been selected by the Jury for award of the 2021 IEI-IEEE Award for Engineering Excellence for significant contributions applying advanced design and analysis of wireless communication and for enhancing the capabilities of mobile communication systems.

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NEWS OF FELLOWS

1	Prof K. Ramesh, FNAE, K Mahesh Chair Professor, Department of Applied Mechanics, IIT Madras, Chennai published a book on "Developments in Photoelasticity: A Renaissance. The book is of interest to Fellows in Mechanical, Civil, Aerospace and Agricultural Engineering Disciplines. The Book launch flyer can be viewed by clicking here…
2	Dr. Debabrata Das, FNAE, Former Professor, Head and Renewable Energy Chair Professor, Department of Biotechnology, Former Professor-in-Charge, P K Sinha Center for Bioenergy, Indian Institute of Technology, Kharagpur delivered a plenary lecture on "BioHythane production using organic wastes: the path towards a sustainable future" in the third International Conference on "Recent advances in bio-energy research (ICRABR-2022)" on March11, 2022 held at Sardar Swaran Singh National Institute of Bio-Energy, Kapurthala. Dr Debabrata Das also was the Distinguished Speaker at Lecture Series on "next generation biofuel Phase 2" delivered offline in the Heritage Institute of Technology Kolkata during April 2022. The Brochure of the Lecture Series can be viewed by clicking here…
3	Prof AB Pandit, FNAE, Vice-President, INAE and Vice-Chancellor, Institute of Chemical Technology, Mumbai has been named the number one scientist in India by Research.com closely followed by Professor of Chemical Engineering- Prof Parag Gogate, FNAE at number two and Professor of Eminence, Dr JB Joshi, FNAE, at number four. These ranking are based on a thorough study of the h-index, publications and citations values of over 10,875 scientists from Google Scholar and Microsoft Academic Graph.
4	Prof Ganti Prasad Rao, FNAE, Member UNESCO_EOLSS Joint Committee, Abu Dhabi, UAE delivered a Talk on "Unique features of Indian Knowledge Systems (IKS) on April 12 2022 during a function organized by Centre of Excellence for India Knowledge Systems, IIT Kharagpur under the aegis of *Azadi Ka Amrit Mahotsav* Celebrations.
5	Dr Archana Sharma, FNAE Director, BTDG, BARC, Mumbai has been selected in top 75 women professionals by PSA, GoI and British High Commission on March 3,2022

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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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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 in February 2022, March 2022, April 2022 and May 2022 are given below.

Dr Subir Kumar Bhattacharyya

(December 25, 1945 – February 1, 2022)

Dr Subir Kumar Bhattacharyya, FNAE, Former Director, SAIL, Ranchi and former Managing Director, Durgapur Steel Plant, born on December 25, 1945 passed away on February 1, 2022. He was elected to INAE Fellowship in the year 1998 and was affiliated to Engineering Section VIII (Mining, Metallurgical and Materials Engineering).

Dr Subir Kumar Bhattacharyya had made significant contributions in the field of Metallurgical Engineering. He was a former President (2003-2004) of the Indian Institute of Metals. The development of Hadfield Steel Plates and coloured stainless steels were some of his notable achievements. Dr Subir Kumar Bhattacharyya graduated in Metallurgical Engineering in 1966 from the then Bengal Engineering College, Shibpur. He did his Ph.D from Massachusetts Institute of Technology (MIT), USA. Thereafter He joined Alloy Steels Plant, Durgapur in 1974 in the Research and Development wing and later became in-charge of the same department. The development of Hadfield Steel Plates and coloured stainless steels were some of his notable achievements. In 1988, he joined R&D Centre for Iron & Steel (RDCIS), Ranchi - the R&D wing of SAIL. He went on to become Director, RDCIS. He took charge as the Managing Director of Durgapur Steel Plant in 2001 and superannuated in December 2005. He played a major role in turning the loss-making plant into a profit-making vibrant Organization. Under his leadership, the rated capacities of major shops were surpassed while there were improvements also in the major techno-economic parameters. He played a major role in the all-round development of DSP, turning the perennially loss-making plant into a profit-making vibrant Organization. He led from the front for the development of special steels in DSP and guided the making of new value-added products thereby creating new marketing opportunities.

He had to his credit 50 publications in national and international journals of repute as well as 5 Indian and foreign Patents He had been closely associated with various educational institutions. Starting with Gold Medal in 1966 from BE College, Dr Bhattacharyya won many Awards and Distinctions. In 1984, he received the National Metallurgists' Day Award of IIM. Other notable Awards & Distinctions are Distinguished Alumnus Award of BE College in 1989, OP Jindal Gold Medal Award of IIM in 1997, Life Fellow of IIM in 1996, Member of Indian National Academy of Engineering (INAE).

May God Bless his Soul to Rest in Peace

Prof Rajinder Kumar

(September 9, 1934- February 7, 2022)

Prof Rajinder Kumar, FNAE, Professor, Department of Chemical Engineering, Indian Institute of Science, Bangalore and Honorary Professor at JNCASR born on September 09, 1934 passed away on February 7, 2022. He was elected to INAE Fellowship in the year 1987 and was affiliated to Engineering Section IV (Chemical Engineering).

Prof. Kumar was born in Punjab and was educated in Punjab and Delhi Universities. He joined Indian Institute of Science, Bangalore, then known as Tata Institute, in 1958 and remained associated with the Institute in various capacities for 64 years till his passing. After his superannuation in 1995, he continued his association with the chemical engineering department at IISc and was also an Honorary professor at JNCASR. A brilliant chemical engineer, Prof Kumar was among the pioneering contributors to an analytical approach to chemical engineering problems in India. His various contributions on multiphase phenomena, in particular bubble and drop phenomena, sonochemistry, foam beds, to mention a few of the many themes he investigated, are well cited and have inspired large tracts of research in those areas. A feature of his approach in research was a keen awareness of the practical angle even as he dwelt in esoteric theoretical concepts. His contributions to what have come to be known as Appropriate technology are well known and documented. Prof Rajinder Kumar, had made significant research contributions in the field of Chemical Engineering including Multiphase Phenomena. He was among the pioneering contributors to an analytical approach to chemical engineering problems. His various contributions on multiphase phenomena, in particular bubble and drop phenomena, sonochemistry, foam beds are well cited and have inspired further research. A feature of his approach in research was a keen awareness of the practical angle along with theoretical concepts.

Prof Kumar's contributions to the engineering profession have been equally stellar. A large part of the credit for building up the chemical engineering department to the status it occupies today as one of the foremost centres of research and learning in the country, goes to him. His contributions on various Government bodies and boards have been very significant. He served IISc in various administrative capacities, and also served on the governing body of CSIR.

Prof Kumar was one of the most highly decorated chemical engineers in the country, with the SS Bhatnagar award from CSIR, Vasvik award, Om Prakash Bhasin award and SS Bhatnagar medal of INSA, to mention a few. He was a Fellow of INSA, IASc and INAE. For his multifarious contributions to the profession and the nation, the Government of India awarded him the Padma Bhushan in 2003.

Above all, Prof Kumar was a warm human being, always jovial and friendly. He was a great nurturer of young talent. His direct students as well as a much larger body of students he touched directly or indirectly have themselves gone on to make very significant contributions to the engineering profession and the country.

May God bless his soul to Rest in Peace.

Written by Prof. A.K. Suresh, FNAE

Mr Vijai Kumar Agarwal

(August 11, 1940 – February 14, 2022)

Mr Vijai Kumar Agarwal, FNAE, born on August 11, 1940 passed away on February 14, 2022. He was elected to INAE Fellowship in the year 1999 and was affiliated to Engineering Section I (Civil Engineering).

Mr Vijai Kumar Agarwal, FNAE, formerly Chairman, Railway Board & Ex-Officio Principal Secretary, Govt. of India and Former Director, Indian Oil Corporation and Steel Authority of India had made significant contributions in the areas of Civil Engineering and Human Resource Development. He was Chairman, INAE Forum on Technology Foresight and Management for Addressing National Challenges. He was also an author of repute having written a book titled "Managing Indian Railways-The Future Ahead". He had also been writing articles on diverse topics like science& spirituality; Environment & ecology as well as on promoting and trying to re-energize Engineering as a profession apart from writing on Railways.

A TRIBUTE

To say that Mr V.K. Agarwal had many sterling qualities, which (formally or informally) moulded a generation of railwaymen, would be a huge understatement. Why so?

First and foremost, he had that most exceptional quality of lending a personal touch to any relationship, he got into, short or long term. He would relish at the idea of making people, feel important (who-so-ever came in contact with him, high or low, small or big*)* so as to be able draw the best out of them, something which endeared him to one and all. And that was the cornerstone of his management philosophy too, which he displayed over an array of varied management skills.

One such attribute was his reach, or should we say his outreach with his team-his people. In no time, in any set up, he could establish a rapport not just with the usual ring of people fencing a senior, but go effortlessly down and across. No artificial barriers of protocol could stop him. He had an intrinsic empathy with people-people by droves felt him as his own.

On the flip side, at all times, he was accessible to one and all-He had ample time on his hands. His juniors always vouchsafed, that when talking to him, you as a person could run out of ideas and issues with him, but he almost never would ever hustle or bundle you out.

Mr Agarwal maintained that people who had worked with him were dear to him. But then what about people whom he didn't know at all or he had never met up with? Mr Agarwal insisted that they on the contrary were very dear to him and explained that because they had dared to cross the barrier and reach out to him, so he at all times was extremely mindful of their needs and concerns.

In other words, on balance-what was he was trying to drive at? He was attempting to introduce a flatter organizational structure. And when, in which era? Way back in the 1960s, 70s, and 80s in the highly hierarchical world of our governmental organizations, when such flat structures were only seen and

heard in the private sector. In management ideas, he was clearly ahead of his times by at least a generation, if not two.

Second, when tackling staff Unions, his skills were straight out of a textbook and beyond. Incidentally to say the least, Indian Railway Unions are one of the most articulate and most proficient across all industries. It was never a case of they vs us. He was intelligent to judge that such a large workforce of railwaymen are an asset and essential part of the setup to be charged and motivated fully. So, he saw in them, his eyes and ears.

When tackling them, he would first try to understand their point of view. He would take care to read the fine print in their Demand-Charter, over and over again. And then only get his point of view across with the Unions, very subtly, amplifying, deliberating on it no-end, till he evolved a consensus. When handling Unions, he always kept two things in mind.

First, he always had ample time on his hands-he was never hurried. He maintained that infect all sensitive matters in life, official or personal, required time and patience to be sorted out.

Two-he was always very firm-He strongly advocated that fearlessly say no to the Unions, but with a reason.

Another of his outstanding personal traits was that he was always very composed at all times, whether in office or in the most stressful of conditions, such as at the accident site. Shouting or being rude was an option he almost never exercised. Infect he never behaved like a Boss, but always like a Leader. Truly speaking he always wore his Crown lightly.

The same cool, composed behaviour of-course extended into his personal life as well, he drawing his amazing strength from-His innate goodness, basically his deep spirituality. And concurrently but most importantly, from acquired strengths honed regularly to perfection. He would maintain a Diary scribbled with copious notes on varied subjects, ranging from Science and Engineering to Ontology and Metaphysics. So, he was in a constant learning and evolving mode. So, he was both current and scholarly.

Last but not the least, another of his beautiful traits was that he was always without rancour. People who knew him well, always vouchsafed that they never ever heard a word of malice from him for anybody. On one occasion it was pointed out to him that somebody somewhere had written something very nasty for him, but he dismissed it by saying that the gentleman concerned was a scholar of sorts and must have had some compulsions to have passed those untoward remarks! In any case he added, it gave him a good chance to do a course correction if any, and maybe improve upon himself.

So not just me alone but many others of my generation in the Railways owe a lot a lot of gratitude to him for setting very high standards of morality, rectitude and ultra-high sensitivity towards peers and juniors, leading us individually to our own paths of success and glory.

May God Bless his Soul to Rest in Peace

By Mr Keshav Chandra, FNAE, Former Railway Board Member

Dr. T.V.S.R. Appa Rao

(February 07, 1941 - February 17, 2022)

Dr. T.V.S.R. Appa Rao, FNAE, Emeritus Scientist, CSIR- Structural Engineering Research Centre (SERC), Chennai and formerly Director, SERC, Chennai born on February 07, 1941 passed away on February 17, 2022. He was elected to INAE Fellowship in the year 1990 and was affiliated to Engineering Section I (Civil Engineering).

Dr. T.V.S.R. Appa Rao had made significant contributions in the areas of Computer Aided Analysis and Design of Structures including Risk and reliability-based design of structures; FEM for advanced structural analysis; Damage Assessment and Vulnerability Analysis of Structures in Cyclone-prone areas; Earthquake-resistant Design of Structures and High-Performance Concretes. During 2005-2007, he contributed to the establishment of the Centre for Disaster Mitigation and Management at the VIT University, Vellore, at the state-of-the-art level that resulted in a number of knowledge products in the area of disaster mitigation.

Dr Appa Rao had a brilliant academic track record and an outstanding professional career. He obtained the first rank with a Gold medal at the Bachelor's degree with Honours in Civil Engineering from the Andhra University in 1962. Because of his exceptional merit, he earned the East-West Centre Fellowship and pursued post graduate studies at the University of Hawaii in the USA; and obtained a Master's degree in Structural Engineering. Thereafter, he obtained his Ph.D. degree from the Cornell University, Ithaca, N.Y., USA in 1968. During 1967-68, he worked as Post-Doctoral Research Fellow at the Cornell University, and thereafter had a brief stint as a consultant in the USA.

Back home in 1969, he joined the team of the then Director, Legendary Professor G.S. Ramaswamy at SERC, located in the campus of the CSIR-Central Building Research Institute in Roorkee. In mid-1970's, SERC finally shifted to its present campus in Chennai. Seldom does an outstanding young scientist morph into an institution-builder, manager and formulator of administrative policy, whose legacy will continue to be cherished and admired by the scientific community. Most would agree that Dr Appa Rao was indeed an exceptional personality. The few who may hesitate, would have to admire the resoluteness of a young engineering student who decided he would go to the US for further studies, and return to head a research institution in a very short time. This was a shining example of his commitment to contribute to the Country's R&D efforts. His first research contribution as SERC Scientist on stress hybrid technique of FEM presented at the First International Conference on Structural Mechanics in Reactor Technology in Berlin, was the forerunner for further research in this area by scientists at the Massachusetts Institute of Technology, U.S.A., and other institutions. Dr. Appa Rao made a unique and strategic contribution for evaluating the safety of nuclear power plant structures by testing a pre-stressed concrete true model of the Madras Atomic Power Project, nuclear reactor containment vessel - first of its kind in India and one among the few in the world!

Dr Appa Rao took over as the fourth Director of SERC on 28th February 1995. During his term as Director, he followed up the cutting-edge R&D creating a niche while nurturing young scientists to take up innovative programs. He initiated the process of establishing world class wind engineering laboratory and the earthquake engineering laboratory (named as ASTaR – Advanced Seismic Testing and Research laboratory) using his technical and administrative skills. While the Wind Engineering Laboratory was established through the UNDP, the ASTaR was built with strong support of the Department of Atomic Energy. As a Societal Scientist through his Project Directorship of the United Nations Development Programme Action Plan he successfully organised transfer of technology for cyclone disaster mitigation, to grass root level artisans/skilled workers. Dr. Appa Rao expected nothing short of excellence by setting his own example from his team in the pursuit of research and deliverables. The industry interaction rose to a different level and so was the demand from the industry seeking powerful yet simple and cost-effective solutions. He was responsible to nominate young scientists to represent in various BIS Committees that provided many of the technologies/processes developed at SERC get due recognition. He mentored several scientists and guided them with timely suggestions. After the thirty-two years of illustrious service rendered by him in the CSIR, Dr. Appa Rao superannuated in 2001 and continued to serve SERC as an Emeritus Scientist.

The nearly four-decade long professional journey of Dr Appa Rao took him to several unchartered territories. Areas of his contributions embraced the fields of Computer-aided analysis and design of complex structures such as ship structures, natural draught hyperbolic parabolic RCC Cooling Towers, offshore structures, pressure vessels & reactors; Risk and reliability-based design of structures; Computer software development; FEM for advanced structural analysis; Integrated software packages for design of structures, Damage Assessment and Vulnerability Analysis of Structures in Cyclone-prone areas; Earthquake-resistant Design of Structures and High Performance Concretes. He served with distinction and provided inspiring leadership/direction as Chairman/Co-Chairman/Member of many International Committees representing Indian Scientific community making significant contributions, and in National Committees leading to outstanding and far reaching decisions and results. He commandeered many national and international events. During 2005-2007, his contribution to the establishment of the Centre for Disaster Mitigation and Management at the VIT University, Vellore, at the state-of-the-art level, jointly with Dr R.K. Bhandari, resulted in a number of knowledge products in the area of disaster mitigation, and auto-certification series for training of professional trainers. He was also a highly valued member of the team responsible for the growth of National Network of Retrofitting Clinics.

Towards nurturing excellence in Science and Technology and for building international partnerships in the field of Structural Engineering, Dr Appa Rao visited many countries including the USA, Germany, Canada, Bulgaria, Japan, DPR Korea, Malaysia and Thailand. He was on the Editorial Board of the International Journal 'Engineering of Structures'.

Awards, rewards and recognitions followed Dr Appa Rao as his shadow. The Cornell University from which he obtained his Doctorate degree, invited him to serve as a Visiting Associate Professor during 1976-77. Later, in September 1989, he served as a Visiting Scholar at the Stanford University, USA. He was one of the distinguished experts of the special S&T delegation deputed to Bulgaria by the Government of India during the eighties. He was the Chief Technical Advisor to the prestigious UNDP Project on Computerisation of the Construction Design and Calculation Centre of DPR Korea. His paper on "Analysis for ship-water interaction effects earned him the Aerospace Engineering Division Gold Medal of the Institution of Engineers (India) in December 1995." The Rotary Club of Madras Metro gave him Vocational Excellence Award in 1998. The very next year, in 1999, he won the CSIR Prize for Engineering Technology' for contributions in the field of computational technology and software

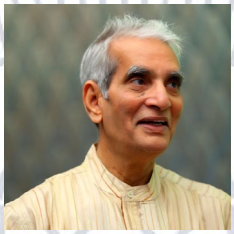
development. And a year later, he received the CSIR Shield for 'Engineering Technology' in the area of Structural Engineering. In November 2003, he received the Indian Building Congress Medal for his paper on Integration of computer and IT applications. In 1990, he was elected as a fellow of the Indian National Academy of Engineering. He published over 125 papers in national and international journals and several monographs.

Dr. Appa Rao has been a tremendous source of inspiration for all of us with his unbounded kindness, high sense of integrity, and tireless and undaunted dedication to service. He was soft spoken gentleman to the core, extremely caring and an excellent human being. The passing away of Dr Appa Rao is a great loss to the entire scientific community.

May God bless his soul to Rest in Peace

Written by Dr RK Bhandari, FNAE

Dr T.S.R. Prasada Rao



(January 20, 1939 –April 7, 2022)

Dr TSR Prasad Rao, FNAE, Chairman, Sarasi Jam Technologies, New Delhi and Formerly Director, Indian Institute of Petroleum, born on January 20, 1939 passed away on April 7, 2022. He was elected to INAE Fellowship in the year 1993 and was affiliated to Engineering Section IV (Chemical Engineering).

Dr TSR Prasada Rao had made outstanding contributions in developing mission-critical technologies that substitute processes available solely from multinational companies. His distinguished service to India was unique and notable because of his passionate and unrelenting efforts to go beyond the laboratory and apply science and engineering to develop and commercialise indigenous technologies for India's industrial development. His Key Word was Develop and Commercialise. He used his science and engineering achievements to develop and commercialise more than 10 technologies in collaboration with leading Indian companies including Bharat Petroleum, Indian Oil, GAIL, Indian Petrochemicals, Reliance, and Cadila Pharmaceuticals. Similarly, Dr Rao led Indian Petrochemicals to acquire catalyst manufacturing capabilities, expanding India's position in the global catalyst manufacturing industry. Besides being an accomplished technocrat, Dr Rao was widely recognised as a successful leader of Indian R&D institutions. As Director of CSIR - IIP during 1990-1999, he combined his passion for science and engineering with his experience in industry to transform the institute from a sick laboratory to a vibrant, world-class innovation centre. Since retiring from Government sector in 1999, Dr. Rao had been passionately championed science-based entrepreneurship in India. He was a recipient of the INAE Life Time Contribution Award in Engineering for the year 2020.

May God bless his soul to Rest in Peace.

Dr AK Bhaduri

(August 28, 1959 - April 27, 2022)

Dr AK Bhaduri, FNAE, Homi Bhabha Chair Former Director, Indira Gandhi Centre for Atomic Research, Kalpakkam born on August 28, 1959 passed away on April 27, 2022. He was elected to INAE Fellowship in the year 2007 and was affiliated to Engineering Section VIII (Mining, Metallurgical and Materials Engineering).

Dr AK Bhaduri, who worked extensively on fast breeder reactors, served as the director of IGCAR, Kalpakkam, from July 2016 to August 2021. He was awarded the Raja Ramanna Fellowship post retirement. He completed his schooling from Calcutta Boys' School in 1978, and subsequently obtained B.Tech. (Hons.) in 1983 and Ph.D. in 1992, in Metallurgical Engineering from the Indian Institute of Technology, Kharagpur. He then joined the training school of Bhabha Atomic Research Centre at Trombay in 1983 and was awarded the Homi Bhabha Medal for topping the batch. Dr Bhaduri joined IGCAR in 1984 to become the Director of Metallurgy and Materials Group and also a Senior Professor of Homi Bhabha National Institute. He received the Humboldt Research Fellowship from the Alexander von Humboldt Foundation, Germany in 1994 and carried out post-doctoral research in University of Stuttgart, Germany for two years. He specialised in the field of materials welding, hardfacing and materials joining and has to his credit more than 220 journal publications, 360 conference presentations and two international patents.

May God bless his soul to Rest in Peace

Dr S Varadarajan

(March 31, 1928- May 11, 2022)

Dr S Varadarajan, one of the Founding Fellows and former President of INAE and Formerly Secretary to the Govt of India, Department of Science and Technology and Formerly Director General, CSIR born on March 31, 1928 passed away on May 11, 2022. He was elected to INAE Fellowship in the year 1987 and was affiliated to Engineering Section IV (Chemical Engineering).

In demise of Dr Srinivasan Varadarajan at New Delhi, one of the leading chemists and among architects of Indian science was lost. He obtained his PhD (1952) from University of Delhi, and also from University of Cambridge, UK (1956). His early work was on benzopyrones and rotenoid natural plant products with biological effects. Starting career as Lecturer of Chemistry, Delhi University (1949-53),

he availed of Exhibition Overseas Fellow with Sir Alexander Todd (1953-56) at Cambridge; Visiting Lecturer in Biology, Massachusetts Institute of Technology, USA (1956-57), Beit Memorial Fellow in Medical Research in Addenbrooks Hospital, Department of Radiotherapeutics, University of Cambridge (1957-59). He returned to India in 1959 to initiate research in Hindustan Lever of the Unilever International Group with which he remained up to 1974.

Later, he was involved in research leading to the synthesis of nucleosides, nucleotides and to the structure of ribonucleic acid (RNA) phosphate linkage, through first cyclo-nucleoside with DM Brown and with Iodine labelled heavy atom and first application of X-ray crystallography in the Laboratory of Sir Lawrence Bragg. His research at the Biology Department of MIT yielded uniformly 14C labelled Thiobacillus denitrificans and Escheria coli deoxynucleotides, converted to triphosphosphates chemically and isolated through first use of lithium bromide, as precursors for biosynthesis of DNA.

During 1975 and 1983, Dr Varadarajan became Chairman of several public sector organisations also. He worked as Secretary to Government of India (1982-88) in the Department of Science and Technology (DST) and was Director General, Council of Scientific Industrial Research (CSIR), and many others. Dr Varadarajan was an efficient manager. He was a Founder Member of the Government Oil Industry Development Board (OIDB) since 1973. He was invited to be Member of Oxford Energy Policy Club, St Anthony's College (1976-83). He has been associated with management of many prestigious institutions like IIM-A; National Council of Applied Economic Research (1976-84), IIT, IISc, Indian Institute of Science, JNU and BHU. He was Trustee of Indira Gandhi National Centre for Arts. He served for 11 years as Chairman of National Commission of Science Museums and assisted in establishment of several Science Museums during 1975-86. He was Member of Public Enterprises Selection Board (1985-88). He was associated with international negotiations for establishment of International Centre for Genetic Engineering and Biotechnology in Delhi and Trieste, and the formation of Indo-French Centre for Advanced Scientific Research in Delhi. Special mention may be made of his work completed on Environmental effects of Refinery on Taj Mahal Monuments (1974-76) and again (1994-95) and on safe disposal of highly toxic stored materials after gas leakage at Bhopal in December 1984.

Dr Varadarajan had been President of INSA (1996-98), Indian Academy of Sciences, Bangalore (1980-82), Indian National Academy of Engineering (1992-95), Nutrition Society of India (1982-86), Oil Technologists Association of India (1984-86) and Treasurer Materials Research Society of India (1990-94). He was Member of International Committee of ICSU on Chemical Research Applied to World Needs (CHEMRAWN); the small India-Japan Eminent Persons Group of Governments and the INSA-Japan Science Advisory Council.

He was also elected Fellow of the all three Science Academy of India; Academy of Sciences for the Developing World (TWAS), and also National Academy of Agricultural Sciences of India, Society of Engineers, All India Management Association, and Jawaharlal Nehru Centre for Advanced Scientific Research. He received CV Raman Medal, INSA Medal for Promotion of Science (2004), and occupied Platinum Jubilee Chair for Promotion and Service to Science (2009-2014). He was conferred the Padma Bhushan from President of India; INAE Lifetime Contribution Award in Engineering in the year 2003 and Life Time Science Award in Petroleum.

May God bless his soul to Rest in Peace.

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ENGINEERING AND TECHNOLOGY UPDATES

Civil Engineering

1. Balancing sustainability, safety and comfort in engineered floor slabs

Using less material in floors is a viable strategy for improving sustainability in buildings, as it can reduce the structure's environmental footprint. Prioritizing only this goal, however, can lead to unwanted effects -- such as an echo in a room or noise traveling between floors, according to Nathan Brown, assistant professor of architectural engineering. Penn State researchers explored a method for optimizing the acoustic and structural properties of concrete floor slabs. "The exciting result of our research is that shaped structures can improve sound insulation performance in buildings while reducing the embodied carbon emissions of the structural system," said Jonathan Broyles, an architectural engineering doctoral candidate and the first author of the paper. To begin their investigation, the team used 3D modeling software to create shaped concrete slabs made up of many curves connected by movable control points. By providing the program with parameters to follow when moving these points, the researchers allowed the software to generate a variety of possible designs with realistic, customized constraints. Continuing the effort to find a favourable design -- a process called optimization -- the researchers needed to test the generated designs' performance in two areas. They analyzed structural properties, for meeting building engineering standards, and acoustic properties, for minimizing undesirable sounds. "Traditional optimization is focused on targeting one value as a good or bad design, but in this case, we have two values: one to evaluate structural performance and another for acoustic performance," said Brown, corresponding author on the paper. "We set up a model with some variables and used a computer algorithm to move through potential designs, targeting better options for both values at the same time." The team used a number of equations to inform their optimization constraints. In addition to considering mass, with a goal of reducing mass to reduce the emissions required to make and install a slab, the researchers also took shape and stiffness into account. Understanding the effect of each of these variables on acoustic properties would allow the team to reduce the power of transmitted sound waves hitting the slab, according to Brown. Using optimization, the researchers identified concrete slab designs that used less concrete than a conventionally shaped slab and maintained desirable acoustic properties. These findings, Brown said, build a foundation for the design of shaped concrete floors that can be optimized for better interaction with sound without compromising sustainability. The team plans to apply the methods used in this research to understand the trade-offs between sustainability and performance in areas beyond acoustics. According to Brown, exploring this connection can lead to more sustainable buildings that do not compromise quality of life.

Source https://www.sciencedaily.com/releases/2022/02/220202165956.htm

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2. Tiny magnets could hold the secret to new quantum computers

Magnetic interactions could point to miniaturizable quantum devices. From MRI machines to computer hard disk storage, magnetism has played a role in pivotal discoveries that reshape our society. In the new field of quantum computing, magnetic interactions could play a role in relaying quantum information. In new research from the U.S. Department of Energy's (DOE) Argonne National Laboratory, scientists have achieved efficient quantum coupling between two distant magnetic devices, which can host a certain type of magnetic excitations called magnons. These excitations happen when an electric current generates a magnetic field. Coupling allows magnons to exchange energy and information. This kind of coupling may be useful for creating new quantum information technology devices. "Remote coupling of magnons is the first step, or almost a prerequisite, for doing quantum work with magnetic systems," said Argonne senior scientist Valentine Novosad, an author of the study. "We show the ability for these magnons to communicate instantly with each other at a distance." This instant communication does not require sending a message between magnons limited by the speed of light. It is analogous to what physicists call quantum entanglement. Following on from a 2019 study, the researchers sought to create a system that would allow magnetic excitations to talk to one another at a distance in a superconducting circuit. This would allow the magnons to potentially form the basis of a type of quantum computer. For the basic underpinnings of a viable quantum computer, researchers need the particles to be coupled and stay coupled for a long time. In order to achieve a strong coupling effect, researchers have built a superconducting circuit and used two small yttrium iron garnet (YIG) magnetic spheres embedded on the circuit. This material, which supports magnonic excitations, ensures efficient and low-loss coupling for the magnetic spheres. The two spheres are both magnetically coupled to a shared superconducting resonator in the circuit, which acts like a telephone line to create strong coupling between the two spheres even when they are almost a centimeter away from each other -- 30 times the distance of their diameters. One additional improvement over the 2019 study involved the longer coherence of the magnons in the magnetic resonator. "Before, we definitely saw a relationship between magnons and a superconducting resonator, but in this study their coherence times are much longer because of the use of the spheres, which is why we can see evidence of separated magnons talking to each other," Li added. According to Li, because the magnetic spins are highly concentrated in the device, the study could point to miniaturizable quantum devices. "It's possible that tiny magnets could hold the secret to new quantum computers," he said.

Source https://www.sciencedaily.com/releases/2022/03/220321115840.htm

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Mechanical Engineering

3. New material could lead to stronger, lighter and safer helmets and vehicles

A team of Johns Hopkins University researchers created shock-absorbing material that protects like a metal, but is lighter, stronger, reusable. The new foam-like material could be a game-changer for helmets, body armor, and automobile and aerospace parts. "We are excited about our findings on the extreme energy absorption capability of the new material," said senior author Sung Hoon Kang, an assistant professor of mechanical engineering. "The material offers more protection from a wide range of impacts, but being lighter could reduce fuel consumption and the environmental impact of vehicles while being more comfortable for protective gear wearers." Kang, who is also a fellow at the Hopkins Extreme Materials Institute, wanted to create a material even more energy-absorbing than current car bumpers and helmet padding. He noticed the typical materials used for these critical protective devices don't perform well at higher speeds and often aren't reusable. The research team was able to add strength while reducing weight with high energy-absorbing liquid crystal elastomers (LCEs), which have been used mainly in actuators and robotics. During experiments to test the material's ability to withstand impact, it held up against strikes from objects weighting about four to 15 pounds, coming at speeds of up to about 22 miles per hour. The tests were limited to 22 miles per hour due to limits of the testing machines, but the team is confident the padding could safely absorb even greater impacts. Kang and his team are exploring a collaboration with a helmet company to design, fabricate, and test next-generation helmets for athletes and the military.

Source https://www.sciencedaily.com/releases/2022/03/220308162838.htm

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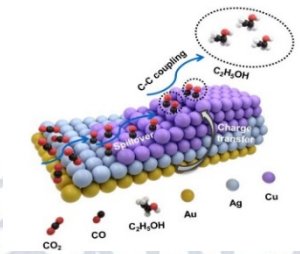
Chemical Engineering

4. Nanostructure Combines Copper, Gold and Silver to Give Carbon Capture and Utilization a Boost



Chemists have developed a nano-scale structure that combines copper, gold, and silver to work as a superior catalyst in a chemical reaction whose improved performance will be essential if carbon capture and utilization efforts are to succeed in helping to mitigate global warming. In the face of the climate change challenge, in recent years, policy-makers have increasingly focused on carbon-capture-and-utilization (CCU), wherein CO2 is drawn down from the atmosphere and then used as a feedstock for industrial chemicals (such as carbon monoxide, formic acid, ethylene, and ethanol) or for the production of carbon-neutral synthetic fuels (especially useful for hard-to-electrify transport sectors such as long-haul aviation and shipping). So long as the latter process is powered by clean electricity, it also offers a way to store renewable energy over the long term—the holy grail of overcoming the intermittency of energy options such as wind and solar power. One possible means of doing all this is via a chemical reaction called the electrochemical CO2 reduction reaction (eCO2RR, or simply ECR). This uses electricity to power the conversion of the gas into other usable substances by separating CO2's carbon atoms from its oxygen atoms. Water can also provide hydrogen "donors" in some varieties of ECR whereby the carbon atoms are combined with hydrogen to produce various species of hydrocarbons or alcohols. Key to ECR is using the right catalyst, or chemical substance whose structure and charge enables it to kick off or speed up a chemical reaction. Various different metals have been used as catalysts depending on which end product is desired. Catalysts employing just one type of metal include tin to produce formic acid, silver for carbon monoxide (CO), and copper for methane, ethylene or ethanol. However, the performance of the process can be limited when ECR competes with the tendency of hydrogen atoms within the electrochemical splitting of water to pair up with themselves instead of joining up with the carbon atoms. This competition can lead to production (or "selection") of a different chemical end product than the one desired. As a result, chemists have long been on the hunt for catalysts with high "selectivity". Recently, instead of just using a single metal as a catalyst, researchers have turned to the use of heterostructures that incorporate two distinct materials whose combined properties produce different or superior outcomes to either of the individual materials on their own. Some of the heterostructures that have been tested for ECR include combining silver and palladium in a branchlike formation (AgPd "nanodentrites"), and various other combinations of two metals in sandwich-like, tube-like, pyramidal and other shapes. Researchers have enjoyed considerable success with bimetallic heterostructures that include copper—which is very good at converting CO2 into products that use two carbon atoms. These bimetallic heterostructures include silver-copper (AgCu), zinc-copper (ZnCu), and gold-copper (AuCu), with the latter enjoying particular selectivity success for methane, C2 and carbon monoxide. So the researchers constructed a trimetallic nanostructure that combined gold, silver and copper and was asymmetric in form. The shape and precise ratio of the three metals can be altered via a growth method involving multiple steps. Specifically, gold "nanopyramids" are first synthesized and used as "seeds" for subsequent growth of various trimetallic structures involving different ratios of the three metals. They found as a result of the unique form of their heterostructure design and by altering the ratios of these three metals, they could carefully tune the selectivity toward different C2-based products. Production of ethanol (C2H6O) in particular was maximized by using a heterostructure with the feeding ratio involving one atom each of gold and silver combined with five copper atoms. The work sets out a promising strategy for development of other trimetallic nanomaterials within ECR development."

Source https://scitechdaily.com/nanostructure-combines-copper-gold-and-silver-to-give-carbon-capture-and-utilization-a-boost

5. **Things are heating up for superconductors**

Researchers at Linköping University have, by way of a number of theoretical calculations, shown that magnesium diboride becomes superconductive at a higher temperature when it is stretched. The discovery is a big step toward finding superconductive materials that are useful in real-world situations. "Magnesiumdiboride or MgB2 is an interesting material. It's a hard material that is used for instance in aircraft production and normally it becomes superconductive at a relatively high temperature, 39 K, or -234 C°," says Erik Johansson, who recently completed his doctorate at the Division of Theoretical Physics. "Magnesium boride has an uncomplicated structure which means that the calculations on the supercomputers here at the National Supercomputer Centre in Linköping can focus on complex phenomena like superconductivity," he says. Access to renewable energy is fundamental for a sustainable world, but even renewable energy disappears in the form of losses during transmission in the electrical networks. These losses are due to the fact that even materials that are good conductors have a certain resistance, resulting in losses in the form of heat. For this reason, scientists worldwide are trying to find materials that are superconductive, that is, that conduct electricity with no losses at all. Such materials exist, but superconductivity mostly arises very close to absolute 0, i.e. 0 K or -273,15 °C. Many years of research have resulted in complicated new materials with a maximum critical temperature of maybe 200 K, that is, -73 °C. At temperatures under the critical temperature, the materials become superconductive. Research has also shown that superconductivity can be achieved in certain metallic materials at extremely high pressure. If the scientists are successful in increasing the critical temperature, there will be greater opportunities to use the phenomenon of superconductivity in practical applications.

"The main goal is to find a material that is superconductive at normal pressure and room temperature. The beauty of our study is that we present a smart way of increasing the critical temperature without having to use massively high pressure, and without using complicated structures or sensitive materials. Magnesium diboride behaves in the opposite way to many other materials, where high pressure increases the ability to superconduct. Instead, here we can stretch the material by a few per cent and get a huge increase in the critical temperature," says Erik Johansson. In the nanoscale, the atoms vibrate even in really hard and solid materials. In the scientists' calculations of magnesium diboride, it emerges that when the material is stretched, the atoms are pulled away from each other and the frequency of the vibrations changes. This means that in this material, the critical temperature increases -- in one case from 39 K to 77 K. If magnesium diboride is instead subjected to high pressure, its superconductivity decreases. The discovery of this phenomenon paves the way for calculations and tests of other similar materials or material combinations that can increase the critical temperature further. "One possibility could be to mix magnesium diboride with another metal diboride, creating a nanolabyrinth of stretched MgB2 with a high superconductive temperature," says Björn Alling, docent and senior lecturer at the Division of Theoretical Physics and director of the National Supercomputer Centre at Linköping University.

Source https://www.sciencedaily.com/releases/2022/03/220322111303.htm

6. Simply printing high-performance perovskite-based transistors

High-performance components in various smart devices have been successfully printed and have attracted much attention. And now, a technology to print perovskite-based devices -- considered a challenge until now -- has been proposed. A POSTECH research team led by Professor Yong-Young Noh and Ph.D. candidates Ao Liu and Huihui Zhu (Department of Chemical Engineering), in collaboration with Professor Myung-Gil Kim (School of Advanced Materials Science and Engineering) of Sungkyunkwan University, has improved the performance of a p-type semiconductor transistor using inorganic metal halide perovskite. One of the biggest advantages of the new technology is that it enables solution-processed perovskite transistors to be simply printed as semiconductor-like circuits. Perovskite-based transistors control the current by combining p-type semiconductors that exhibit hole mobilities with n-type semiconductors. Compared to n-type semiconductors that have been actively studied so far, fabricating high-performance p-type semiconductors has been a challenge. Many researchers have tried to utilize perovskite in the p-type semiconductor for its excellent electrical conductivity, but its poor electrical performance and reproducibility have hindered commercialization. To overcome this issue, the researchers used the modified inorganic metal halide caesium tin triiodide (CsSnI3) to develop the p-type perovskite semiconductor and fabricated the high-performance transistor based on this. This transistor exhibits high hole mobility of 50cm2V-1s-1 and higher and the current ratio of more than 108, and recorded the highest performance among the perovskite semiconductor transistors that have been developed so far. By making the material into a solution, the researchers succeeded in simply printing the p-type semiconductor transistor as if printing a document. This method is not only convenient but also cost-effective, which can lead to the commercialization of perovskite devices in the future. "The newly developed semiconductor material and transistor can be widely applicable as logic circuits in high-end displays and in wearable electronic devices, and also be used in stacked electronic circuits and optoelectronic devices by stacking them vertically with silicon semiconductors," explained Professor Yong-Young Noh on the significance of the study.

Source https://www.sciencedaily.com/releases/2022/03/220325093915.htm

Aerospace Engineering

7. Owl wing design reduces aircraft, wind turbine noise pollution

Trailing-edge noise is the dominant source of sound from aeronautical and turbine engines like those in airplanes, drones, and wind turbines. Suppressing this noise pollution is a major environmental goal for some urban areas. Researchers from Xi'an Jiaotong University used the characteristics of owl wings to inform airfoil design and significantly reduce the trailing-edge noise. "Nocturnal owls produce about 18 decibels less noise than other birds at similar flight speeds due to their unique wing configuration," said author Xiaomin Liu. "Moreover, when the owl catches prey, the shape of the wings is also constantly changing, so the study of the wing edge configuration during owl flight is of great significance." Trailing-edge noise is generated when airflow passes along the back of an airfoil. The flow forms a turbulent layer of air along the upper and lower surfaces of the airfoil, and when that layer of air flows back through the trailing edge, it scatters and radiates noise. Previous studies explored serrated trailing edges, finding that the serrations effectively reduce the noise of rotating machinery. However, the noise reduction was not universal, depending heavily on the final application. "At present, the blade design of rotating turbomachinery has gradually matured, but the noise reduction technology is still at a bottleneck," said Liu. "The noise reduction capabilities of conventional sawtooth structures are limited, and some new non-smooth trailing-edge structures need to be proposed and developed to further tap the potential of bionic noise reduction." The team used noise calculation and analysis software to conduct a series of detailed theoretical studies of simplified airfoils with characteristics reminiscent of owl wings. They applied their findings to suppress the noise of rotating machinery. Improving the flow conditions around the trailing edge and optimizing the shape of the edge suppressed the noise. Interestingly, asymmetric serrations reduced the noise more than their symmetric counterparts. Noise reduction varied with different operating conditions, so the scientists emphasized that the airfoil designs should be further evaluated based on the specific application. For example, wind turbines have complex incoming flow environments, which require a more general noise reduction technology. Examining noise reduction techniques under the influence of different incoming flows would make their conclusions more universal. The researchers believe their work will serve as an important guide for airfoil design and noise control.

Source https://www.sciencedaily.com/releases/2022/01/220118111351.htm

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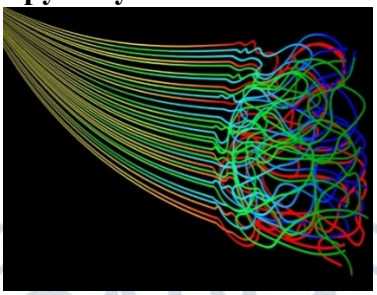
8. Zentropy: New Theory of Entropy May Solve Materials Design Issues



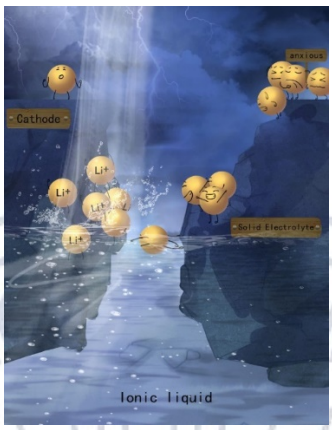
Entropy is the measure of the disorder in a system that occurs over a period of time with no energy put into restoring the order. Zentropy integrates entropy at multiscale levels.

A challenge in materials design is that in both natural and manmade materials, volume sometimes decreases, or increases, with increasing temperature. While there are mechanical explanations for this phenomenon for some specific materials, a general understanding of why this sometimes happens remains lacking. However, a team of Penn State researchers has come up with a theory to explain and then predict it: Zentropy. Zentropy is a play on entropy, a concept central to the second law of thermodynamics that expresses the measure of the disorder of a system that occurs over a period of time when there is no energy applied to keep order in the system. Think of a playroom in a preschool; if no energy is put into keeping it tidy, it quickly becomes disordered with toys all over the floor, a state of high entropy. If energy is put in via cleaning up and organizing the room once the children leave, then the room returns to a state of order and low entropy. Zentropy theory notes that the thermodynamic relationship of thermal expansion, when the volume increases due to higher temperature, is equal to the negative derivative of entropy with respect to pressure, i.e., the entropy of most material systems decreases with an increase in pressure. This enables Zentropy theory to be able to predict the change of volume as a function of temperature at a multiscale level, meaning the different scales within a system. Every state of matter has its own entropy, and different parts of a system have their own entropy. The authors of the study, believe that Zentropy may be able to predict anomalies of other physical properties of phases beyond volume. This is because responses of a system to external stimuli are driven by entropy. Macroscopic functionalities of materials stem from assemblies of microscopic states (microstates) at all scales at and below the scale of the macroscopic state of investigation. These functionalities are challenging to predict because only one or a few microstates can be considered in a typical computational approach such as the predictive "from the beginning" calculations, which help determine the fundamental properties of materials. Zentropy theory "stacks" these different scales into an entropy theory that encompasses the different elements of an entire system, presenting a nested formula for the entropy of complex multiscale systems, according to Liu. This approach has been something Liu's lab has worked on for more than 10 years and five different published studies. Zentropy has potential to change the way materials are designed, especially those that are part of systems that are exposed to higher temperatures. These temperatures, given thermal expansion, could cause issues if the materials expand. "This has the potential to enable the fundamental understanding and design of materials with emergent properties, such as new superconductors and new ferroelectric materials that could potentially lead to new classes of electronics," Liu said. "Also, other applications such as designing better structural materials that withstand higher temperatures are also possible." While there are benefits for society in general, researchers could apply Zentropy to multiple fields. This is because of how entropy is present in all systems. "The Zentropy theory has the potential to be applied to larger systems because entropy drives changes in all systems whether they are black holes, planets, societies or forests," Liu said.

Source https://scitechdaily.com/zentropy-new-theory-of-entropy-may-solve-materials-design-issues

Energy Engineering

9. Ionic Liquids Make a Splash in Next-Generation Solid-State Lithium Metal Batteries



Quasi-solid-state-electrodes realize a significant reduction in interfacial resistance. Researchers from Tokyo Metropolitan University have developed a new quasi-solid-state cathode for solid-state lithium metal batteries, with significantly reduced interfacial resistance between the cathode and a solid electrolyte. By adding an ionic liquid, their modified cathode could maintain excellent contact with the electrolyte. Their prototype battery also showed good retention of capacity. Though finding the best ionic liquid remains challenging, the idea promises new directions in solid lithium battery development for practical applications. Lithium-ion batteries have become ubiquitous, finding a place in our smartphones, laptops, power tools, and electric vehicles. But as we look for better solutions with higher energy density, scientists have been turning to solid-state lithium metal batteries. Li metal batteries potentially have much higher energy density than their Li-ion counterparts. They are seen as the future of batteries, powering vehicles and grids on massive scales. However, technical issues keep solid-state lithium metal batteries from making their way into demanding applications. A major one is the design of the interface between electrodes and solid electrolytes. Electrolytes in Li-ion batteries are usually liquid and highly flammable, posing a safety hazard. That's why people have been trying to use a solid-state electrolyte instead. However, it is difficult to achieve good contact between electrodes and solid electrolytes. Any surface roughness on either side leads to high interfacial resistance, which plagues battery performance. There has been some work looking at the design of the solid electrolyte, but cathode design remains an open issue. A team led by Prof. Kiyoshi Kanamura of Tokyo Metropolitan University have been developing new ways of improving the contact between the cathode and solid-state electrolyte in solid-state lithium metal batteries. Now, they have succeeded in creating a quasi-solid-state lithium cobalt oxide (LiCoO2) cathode which contains a room-temperature ionic liquid. Ionic liquids consist of positive and negative ions; they can also transport ions. Importantly, they can fill any tiny voids at the cathode/solid electrolyte interface. With the voids filled, the interfacial resistance was significantly decreased. The team's method has other benefits too. Ionic liquids are not only ionically conductive but almost non-volatile and usually non-flammable. They also have minimal effect on the slurry from which the cathode is formed, leaving the manufacturing process virtually untouched. The team demonstrated a prototype battery made with their quasi-solid-state cathode and a solid "garnet" electrolyte (referring to its structure), which showed good rechargeability, with 80% capacity retention after 100 charge/discharge cycles at an elevated temperature of 60°C. Further study also revealed an optimal ionic liquid content of 11wt%. Issues remain, like finding a better ionic liquid that doesn't degrade as easily. However, the team's new paradigm promises exciting new directions for research into solid-state lithium metal batteries, with the potential to bring them out of the lab, and into our lives.

Source https://scitechdaily.com/ionic-liquids-make-a-splash-in-next-generation-solid-state-lithium-metal-batteries/

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

10. Breakthrough application of moisture-trapping film to reduce heat stress in personal protective suits

A team of researchers from the National University of Singapore (NUS) has developed a novel super-hygroscopic material that enhances sweat evaporation within a personal protective suit, to create a cooling effect for better thermal comfort for users such as healthcare workers and other frontline officers. The new desiccant film, which is biocompatible and non-toxic, has fast absorption rate, high absorption capacity and excellent mechanical properties. This means that the material is very robust and durable for practical applications such as for protective suits worn by healthcare workers. It is also affordable, light-weight, easy to fabricate and reusable. Attaching a piece of novel composite film in a protective suit -- for example at the back of the suit -- could bring down the heat index by about 40%, remarkably lowering the likelihood of heat stroke. This research breakthrough demonstrates the positive outcome of leveraging the complementary strengths of NUS and HTX to create tangible benefits for the Home Team and the wider community. By combining the NUS team's scientific knowledge of advanced hydrogel materials and HTX's deep understanding of the Home Team's needs and engineering capabilities, the joint research team was able to customise and optimise the novel moisture-trapping material for practical applications to enhance the performance and productivity of frontline officers. Medical protective suits have excellent anti-bacterial and water-proof properties. However, this high level of protection stops the venting of water vapour produced by evaporated sweat and impedes heat loss from the body. This is why users such as healthcare workers who need to don protective suits for long hours, especially in tropical environments, often report of occupational heat strain. Thermal management solutions such as air-cooling garments with electrical fans or ingestion of ice slurry are impractical due to limitations such as bulkiness, heavy weight, and limited effectiveness. While advanced textiles and coatings are promising solutions, they are difficult to fabricate and production costs are high. The NUS team came up with a practical strategy to overcome the current challenges by leveraging the principle of evaporative cooling. Their solution involves using a super-hygroscopic composite film to control the humidity level in the micro-environment in the protective suit. When the moisture-trapping composite film absorbs water vapour within the protective suit, the humidity level drops. This in turn speeds up sweat evaporation from the skin. As a result, more heat is dissipated from the human body through sweating, providing thermal comfort for users such as healthcare workers. To examine the effectiveness of their solution, the NUS team conducted tests in collaboration with researchers from HTX, using a 20-zone 'Newton' manikin within a climatic chamber. This is an important experimental milestone in assessing the feasibility of applying the composite film to the scale of full body clothing. With the composite film, relative humidity (RH) under moderate sweating condition dropped by about 40% -- from 91% to 48.2% after one hour of sweating and to 53.2% after two hours of sweating. The team also found that within the first hour of sweating, the heat index or 'felt air temperature' dropped significantly from 64.6 deg C to 40 deg C at air temperature of 35 deg C. At this level, while users still feel hot, the likelihood of getting heat stroke, heat cramps and heat exhaustion is remarkably reduced. In another laboratory experiment, the research team also showed that body temperature (or skin temperature) could be significantly reduced by 1.5 deg C through evaporative cooling. This further proves that the composite film can potentially help users -- such as healthcare workers, soldiers or firefighters -- relieve thermal stress, especially during strenuous activities. Regeneration of the NUS team's composite film is also more energy efficient, as it requires a lower temperature to release the trapped moisture. At 50 deg C, the composite film releases 80% of its water contents after 10 minutes and this reaches 95% after 40 minutes. Most hygroscopic materials regenerate at a temperature of more than 100 deg C, over a duration of more than an hour. Encouraged by the results

of their latest study, the NUS team is now working to improve their hygroscopic material so that it can absorb more and faster. The team is also planning to apply their cooling strategy to other types of protective apparel such as those for firefighters.

Source https://www.sciencedaily.com/releases/2020/12/201222132002.htm

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ENGINEERING INNOVATION IN INDIA

ISRO launches PSLV-C52 with earth observation and 2 small satellites

The Indian Space Research Organisation (ISRO) on Monday (February 14, 2022) launched the Polar Satellite Launch Vehicle, which also carried two small co-passenger satellites.The Earth observation satellite EOS-04 and two small satellites were successfully placed into the desired orbit by the PSLV-C52 rocket after they were launched at 05:59 AM from the first launch pad of Satish Dhawan Space Centre at Sriharikota in Andhra Pradesh. This, notably, is ISRO's first launch mission of 2022.

EOS-04 is a Radar Imaging Satellite designed to provide high-quality images under all weather conditions for applications such as Agriculture, Forestry and Plantations, Soil Moisture and Hydrology and Flood mapping.

The PSLV-C52 also blasted off with two small satellites as co-passengers, including a student satellite (INSPIREsat-1) from the Indian Institute of Space Science and Technology (IIST) in association with the Laboratory of Atmospheric and Space Physics at the University of Colorado, Boulder. Two scientific payloads in this satellite are to improve the understanding of ionosphere dynamics and the sun's coronal heating processes. The other is a technology demonstrator satellite (INS-2TD) from ISRO, which is a precursor to the India-Bhutan Joint Satellite (INS-2B). Having a thermal imaging camera as its payload, the satellite benefits the assessment of land surface temperature, water surface temperature of wetland or lakes, delineation of vegetation (crops and forest) and thermal inertia (day and night). This is the 54th flight of PSLV and 23rd Mission using PSLV-XL configuration with 6 PSOM-XLs (strap-on motors).

Source https://zeenews.india.com/india/isro-launches-pslv-c52-with-earth-observation-and-2-small-satellites-watch-2436290.html

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