INDIAN NATIONAL ACADEMY OF ENGINEERING

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INAE VISION 2020-2025

INAE VISION

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

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INAE Vision

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

INAE White Paper on Technological Preparedness for Dealing with National Disruptions

INAE prepared a White Paper on "Technological Preparedness for dealing with National Disruptions". Dr. B.N. Suresh, Immediate Past -President, INAE had prepared the base paper in this regard. Inputs by Dr. P.S. Goel, former President, INAE and Dr. Bhujanga Rao, and members of the Apex Committee had already been incorporated in the draft material. Besides this the draft White Paper has also been circulated to the Conveners of the Sectional Committees and 22 other selected domain experts from INAE Fellowship. The White Paper on "Technological Preparedness for dealing with National Disruptions" integrating all the inputs was compiled by Dr BN Suresh and forwarded to Shri Amitabh Kant, CEO, NITI Aayog; Dr VK Saraswat, Member, NITI Aayog; Prof K VijayRaghavan, PSA to Govt. of India and Prof Ashutosh Sharma, Secretary, DST, Govt. of India with a request for an opportunity of consulting with them over a WebEx meeting to take this initiative forward. Positive response had been received from DST to take this initiative ahead.

In response to this initiative, NITI Aayog convened a meeting, through 'Video Conferencing' on 10th August 2020 to be chaired by Dr. VK Saraswat, Member, NITI Aayog to discuss the future course of action to implement the recommendations of the White Paper on **'Technological Preparedness for dealing with National Disruptions'**, with a view to take the initiative forward. Accordingly, the said meeting was attended by Dr. Sanak Mishra, President, INAE, Dr. BN Suresh, Immediate Past-President, INAE, Dr. PS Goel, Former President, INAE, Dr. VK Saraswat, Member, NITI Aayog; Shri Neeraj Sinha, Adviser (S&T) and Dr. Ashok A Sonkusare, Jt. Adviser (S&T), NITI Aayog and Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE. The meeting was successfully concluded to arrive at an action plan to implement the recommendations suggested in the subject White Paper. It was suggested that an Apex Committee be constituted with member experts from INAE and NITI Aayog who would further identify Sub-committees to take up specific task envisaged to take this initiative to its logical conclusion. In the month of September 2020, INAE has requested NITI Aayog, DST, CSIR/DSIR, IMD, NDMA, DRDO, DBT, ICMR, Coast Guard, ISRO, DAE to nominate representatives for the "Peer Committee" to progress the initiative and suitable responses are being received in this regard.

Fellowship and Awards

- **Election of Fellows/ Foreign Fellows w.e.f. November 1, 2020**

The list of newly elected Fellows/Foreign Fellows w.e.f. November 1, 2020 has been uploaded on INAE website and can be viewed at the link given below.

https://www.inae.in/fellowship-youth-activities/fellowship/nomination-information

- **Life Time Contribution Award in Engineering 2020, Prof Jai Krishna & Prof SN Mitra Memorial Awards 2020, Outstanding Teachers Award 2020, INAE Woman Engineer of Award for the Year 2020, INAE Young Entrepreneur Award 2020 and INAE Young Engineer Award 2020**

The lists of Life Time Contribution Award in Engineering Awardees for the year 2020, Prof Jai Krishna & Prof SN Mitra Memorial Awardees for the year 2020, Outstanding Teachers Awardees for the year 2020, INAE Woman Engineer of Awardees for the Year 2020, INAE Young Entrepreneur Awardees 2020 and INAE Young Engineer Awardees 2020 have been uploaded on INAE website and can be viewed at the links given below.

Recipients of Life Time Contribution Award in Engineering 2020

https://www.inae.in/life-time-contribution-award-in-engineering

Recipients of Prof Jai Krishna & Prof SN Mitra Memorial Awards 2020

https://www.inae.in/professor-jai-krishna-and-professor-sn-mitra-memorial-awards

Recipients of INAE Outstanding Teachers Award 2020

https://www.inae.in/inae-outstanding-teachers-award-awards

Recipients of INAE Woman Engineer of the Year Award 2020

https://www.inae.in/women-engineer-of-year-award

Recipients of INAE Young Entrepreneur Award 2020

https://www.inae.in/inae-innovator-entrepreneur-award

Recipients of INAE Young Engineer Award 2020

https://www.inae.in/inae-young-engineer-award-2018

INAE Webinar Series

INAE in the year 2020, launched a Webinar Series on topics encompassing all sectors and disciplines of engineering and technology. The INAE Webinar Series is an important new initiative of the INAE Digital Platform. The first Webinar on May 23, 2020 featured two talks, one on "Launch of INAE Webinar Series" by Mr K Ananth Krishnan, FNAE, EVP and CTO, TCS and a technical talk on "Enterprise Digital Twin" by Mr Vinay Kulkarni, FNAE, Chief Scientist, TCS Research. The second Webinar was held on 13th June 2020 on the topic "Does Hydrogen have a role in India's Energy Strategy?" and the four speakers were Dr. SSV Ramkumar, Director R&D, IOCL; Dr. Ashish Lele, Senior VP and Head, Advanced Materials and Alternate Energy, Reliance Industries Limited; Dr. RR Sonde, EVP, Research, Technology and Innovation, Thermax and Dr. P C Maithani, Advisor, MNRE, Govt. of India. Mr MV Kotwal, Ex - Member of L&T Board & President, Heavy Engineering was the Moderator of the second webinar. The third Webinar was held on July 25, 2020 on "Strategy for Accelerated Growth of Renewable Energy Application in India". The webinar commenced with opening statement by Dr. Sanak Mishra, President, INAE and was moderated by Mr. Pradeep Chaturvedi. The Webinar had expert panellists: Dr. Ajay Mathur, Director General, TERI; Mr. Sumant Sinha, CMD, ReNew Power; Mr. K. S. Popli, former CMD, IREDA and Advisor, International Solar Alliance; Dr. P.C. Maithani, Advisor, Ministry of New and Renewable Energy and Dr. B. Bandyopadhyay, former Advisor, MNRE. The recordings of all three Webinar have been uploaded in INAE You tube account and an access has been provided on INAE website.

The recordings of the three webinars can be viewed at the links given below.

First Webinar: https://www.youtube.com/watch?v=LnAT72HT5Ws&feature=youtu.be

Second Webinar: https://www.youtube.com/watch?v=DpD5jt9hDSw

Third Webinar: https://www.youtube.com/watch?v=o0sIPGGKtFQ

INAE Local Chapter Activities

INAE Local Chapters organized a number of interesting webinars/activities in the recent past which are summarized below.

INAE Kanpur Chapter

The 7 - Day "e-BOOTATHON 01 Virtual Labs Development" was held in association with INAE Kanpur Chapter, IIT Kanpur & AKTU Lucknow which was organized by Rajkiya Engineering College, Banda from August 04 - 10, 2020. The 7-day **e-BOOTATHON** program was organized to develop virtual experiments on an open platform. The event witnessed registration of 43 teams and a participation of 215 attendees. A total of 13 colleges were screened to qualify for the development program to make 15 teams with 60 students and 15 faculty mentors.

The e-BOOTATHON event was inaugurated by Prof. Vinay Pathak, Vice Chancellor of AKTU, Lucknow. Professor Pathak emphasized that Virtual Lab is one of the key initiatives to develop the cognitive skills of the AKTU students. Over 130 participants attended the online inauguration ceremony. Prof. S.P. Shukla, Director REC Banda, informed that Virtual Labs are mapped to seven engineering branches with Applied Sciences experiments with a total of 330 experiments mapped to the curriculum of AKTU experiments. AKTU is also taking an initiative to develop laboratories for pharmaceutical sciences as well. Prof. Subodh Wariya, Dean UGSE AKTU Lucknow stated that the Virtual Laboratory Cell will cater to the needs of students to develop hands on experience in using Virtual Labs. Prof. Kantesh Balani, PI Virtual Labs and Secretary INAE Kanpur Chapter, appreciated the e-BOOTATHON 01 event and later gave a keynote talk on the 'Introduction to Virtual Laboratories' and how it can be effectively utilized.

Prof. Yogesh M Joshi, Vice Chair, INAE Kanpur Chapter, appreciated the Virtual Laboratory initiative and stated that virtual labs are the need of the hour especially due to the pandemic when everyone is utilizing online platforms to a great extent. He also praised the e-BOOTATHON 01 event which helps student learn and perform experiments online.

During e-BOOTATHON, Er. Dhananjay Umrao and Er. Sheetal Singh delivered 16 sessions, where they demonstrated the development procedure and pedagogical concepts of virtual lab development. Dr. Sangeeta Arora KIET Ghaziabad, Dr. Arvind Pandey MIET Meerut, Dr. Anurag Chauhan REC Banda and Mr. T. Senthil Siva Subramanian HCST, Mathura mentored and guided the students by giving their valuable reviews which enhanced the participant's understanding of v-lab development.

The valedictory ceremony was conducted on August 10, 2020, where 15 teams from various colleges of engineering showcased their experiments in several disciplines of engineering. These teams were able to develop 23 experiments of AKTU in all. The program ended with the vote of thanks proposed by Dr. Ashutosh Tiwari to AKTU, IIT Kanpur, INAE Kanpur Chapter and TEQIP -III for supporting in the e-BOOTATHON 01. He also congratulated all the successful participants, faculty members and mentor that led to the successful development of quite a few new virtual experiments for AKTU.

INAE Hyderabad Chapter

The School of Engineering Sciences and Technology (SEST), University of Hyderabad has organized the following webinars, jointly with the INAE Hyderabad Local Chapter.

S. No.	Speaker	Title of the Presentation	Date
1.	**Dr. G. Padmanabham,** Director, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad	Metallurgical Aspects of Additive Manufacturing	19 August 2020
2.	**Prof. Satyam Suwas,** Chairman, Department of Materials Engineering, Indian Institute of Science, Bangalore.	Microstructure and Texture in Processing of Metals and Alloys	21 August 2020
3.	**Prof. B. S. Murty,** Director, Indian Institute of Technology, Hyderabad.	Probing Materials at Small Scale: The Exciting World at the Bottom	23 August 2020

In all the above webinars more than 150 faculty/scientists/researchers/students have attended from all over the country as well as from Japan, Germany and the USA. The participants have enthusiastically interacted with the distinguished speakers.

INAE Kolkata Chapter

INAE Kolkata Chapter celebrated National Engineers' Day on 15 September 2020 and on this occasion, Prof. Anupam Basu, FNAE, Director, NIT Durgapur and Professor-on-lien, Department of Computer Science and Engineering, IIT Kharagpur delivered the Engineers' Day Lecture on "Artificial Intelligence and Ethics". In view of the world pandemic, this lecture was arranged in virtual mode in the evening hours of the day. This was attended by 85 participants from different parts of the country including several INAE Fellows, INAE Young Associates, practising engineers, professors, and students from the different engineering institutes. In his talk, Prof. Basu discussed the ever increasing presence of Artificial Intelligence in the every facet of our modern life. He vividly addressed the ethical issues which are rooted in the technology itself. His talk was well received by the audience and it raised very interesting and enthusiastic discussions among the participants.

The meeting began with a formal welcome address by Prof. Bhargab B. Bhattacharyya, President, INAE Kolkata Chapter. He briefly described the aim and goal of INAE in general, including the activity of the Local Chapter. The founding President of the Chapter, Prof. Sankar K. Pal, National Science Chair, Distinguished Scientist and former Director, Indian Statistical Institute, Kolkata, addressed the audience and explained the significance of National Engineers' Day. He also encouraged the young engineers to elevate their career with INAE. Prof. Debatosh Guha, Secretary, INAE Kolkata Chapter conducted the proceedings of the meeting and also briefed the audience with various recent technical activities of Kolkata Chapter.

INAE Mumbai Chapter

INAE Mumbai Chapter organized a Webinar Lecture delivered by Prof. Vijay M. Naik, FNAE, Department of Chemical Engineering, IIT Bombay on Hypothetico-Deductive "Construction" of New

Knowledge in Industrial R&D and Academic Research on occasion of the National Engineers' Day on Tuesday 15 September 2020.

Prof Vijay M. Naik – Department of Chemical Engineering – IIT Bombay gave a talk on the topic "Hypothetico-Deductive 'Construction' of New Knowledge in Industrial R&D and Academic Research" on the 15th of September, Engineers' Day, from 5 pm onwards. This was the second talk in the Webinar series of the INAE Mumbai Chapter, and was hosted by INAE Headquarters on their national WebEx platform. The event was well attended with over 100 participants. Prof A.K. Suresh Ex Dy Director IIT Bombay and co-Chair, INAE Mumbai Chapter, welcomed the gathering and introduced the speaker. In his brief address, Prof Suresh recalled the many contributions of Bharat Ratna Sir M Visvesvaraya, one of the architects of modern India, and his sterling qualities of head and heart. He then proceeded to introduce the speaker, Prof Vijay M. Naik who after a distinguished career in Industrial R&D marked by several innovations in the FMCG sector, continues to be active in research as an Adjunct Professor at IIT Bombay. Prof Naik also contributes significantly to the profession in various capacities, including as a member/chairperson of several grant-making committees, research advisory bodies of CSIR Laboratories etc.

Prof Naik followed up with his lecture, in which he began by acknowledging the visionary insights of Bharat Ratna Visveswaraya regarding the role of technology in social and economic transformation. He went on to explain how technology predates even Homo Sapiens and then discussed how empirical observations and serendipity have been not only the foundations of many manmade technological artefacts but also the triggers for discovery of most scientific laws of nature. According to him, human creative intuition has been the source of articulating a candidate hypothesis which tries to identify the magical hidden pattern underpinning chaotic empirical observations. Deduction is the art of searching for a logical understanding and implications of an articulated assertion. But ultimately, we must accept what Richard Feynman says, -- we do not understand what we cannot create……. until we create. This is the spirit of scientific enquiry and the basis of "construction of new knowledge", as well as refuting or improving "existing knowledge", transcending revered texts. This paradigm of construction of scientific knowledge is valid for both Natural Sciences and Engineering Sciences. Any meaningful Industrial R&D is not merely application of science. It is a cognitive activity of creatively constructing new knowledge, just as any worthwhile Academic Research should ideally be. Therefore, although their domains and purpose are different, the mind of an adventurous Engineer engaged with a breakthrough Product Development and the mind of a true Academic engaged with leading edge research in Science, exhibit similar ways of working. The talk presented a case study of such hypothetico-deductive ways of working in avant-garde Academic Research in the area of Neuro science, as well as Industrial Product Development in the area of distribution of frozen foods. The talk also briefly touched upon the challenge of nurturing such Creative Talent in Industrial R&D Labs, and the need of awakening minds of Engineering Students towards epistemology of science.

The talk was followed by a lively discussion session moderated by Prof Suresh, in which the attendees sought Prof Naik's views on various philosophical and practical aspects of research, innovation and development. The event was brought to a closure with a formal vote of thanks by Secretary, INAE Mumbai Chapter.

INAE Bangalore Chapter

INAE Bangalore Chapter organized a Webinar on "S&T Contributions of the Bangalore Region to the National Efforts against COVID-19" on the occasion of National Engineers' Day on 15th September 2020. There were 5 presentations in the Webinar ; (i) Prof Raghavan Varadarajan , IISc on "A Protein Sub-unit Vaccine for COVID-19" ii) Shri JJ Jadhav, Director, CSIR-NAL on "S&T Contributions of CSIR-NAL to the National Efforts against COVID-19" , also mentioning contributions by other CSIR Laboratories (iii) Shri MV Gowtama, CMD, BEL on "BEL's Contributions against COVID-19" (iv) Dr

NS Kumar, Associate Director, DEBEL-DRDO on "Contributions from DEBEL -DRDO for COVID-19" and (v) Prof Rahul Roy, IISc on "Monitoring Immune Response in COVID-19 Infections", also mentioning other initiatives from IISc. Dr VK Aatre, former SA to RM, DG, DRDO and Secretary, Dept. of Defence Research, MOD and current Chairman, INAE BC made a brief introductory address on the COVID-19 situation in the country and the national efforts towards its treatment and containment. Prof KJ Vinoy, IISc proposed a vote of thanks on behalf of EC of INAE BC. The webinar was attended by more than 40 Fellows/Young Associates/Student Awardees.

INAE Delhi Local Chapter

INAE Delhi Local Chapter organized a Webinar talk by Prof PV Madhusudan Rao, Abdul Kalam Technology Innovation National Fellow of INAE and Mehra Chair Professor, IIT Delhi on "Enriching Engineering Education throughExperiential, Collaborative, and Social Learning" held on September 24, 2020. Brief details of the talk are given below.

Prof. P. V. Madhusudan Rao gave a webinar presentation on 24/9/2020 over MS Teams that was organized by Bharti School of Telecom, IIT Delhi, and INAE Delhi Chapter. The talk title was "Enriching Engineering Education through Experiential, Collaborative, and Social Learning." In his talk, Prof. PVM Rao first introduced the key tenets of engineering education, especially how it should affect in cultural and social changes, and contrasted with the trends of engineering education where the focus has been primarily classroom pedagogy and examination oriented. He pointed out the routine complaints that a professor makes about the lack of interest in the current-day students, as well as the complaints of the students on how they do not find the class room teaching interesting. He pointed out that, especially in Indian engineering education the first year of the students, the students are loaded with basic physics, chemistry, and Mathematics, whereas they need to be first motivated on the aspects and impacts of their upcoming education. As a result, many lose interest inthe first year itself.

Prof. Rao then shared how a curriculum change in the first year at IIT Delhi has been affected to address this critical issue of motivating the students. A new course on "Introduction to Engineering" has been initiated 8 years ago at IIT Delhi with his leadership. In the course, through the semester eminent engineering and entrepreneurial personalities are invited every about 2 weeks for a lecture and extensive interactions with the entire class of students (currently about 1100 in number). Parallelly, the students are exposed to various projects where they start with basic science concepts and in a few days of group effort they come up with engineering outcomes — so show the connection between science and engineering. He also shared his rich experience on similar design and social learning-oriented engineering innovations through the academic courses, wherein the student put in much more efforts beyond their routine work hours out of their sheer interest. Prof. Rao also connected his experiences at MIT and Stanford on similar lines of education.

To summarize, his talk pointed to the need of making efforts as the educators on how to engage the students to do something meaningful, and then drawing their interest towards the fundamentals of deeper learning through the pedagogical aspects. The talk was broadcast to the entire INAE community across the country as well as the IIT Delhi academic community, and was attended by 32 online participants, including the engineering faculty members, industry practitioners, and students. Overall, it was a fine interactive session with live exchange of thoughts following the presentation.

Brief Bio of the Speaker: P. V. Madhusudhan Rao is professor in Department of Mechanical Engineering, Department of Design and Khosla School of Information Technology at IIT Delhi. He also serves as Head of the Department of Design. His current teaching and research interests are in product design and manufacturing with special emphasis on design of medical and assistive devices. He obtained his Ph.D from IIT Kanpur. He was a guest researcher to US Government's National Institute of Standards & Technology (NIST), USA multiple times between 1996-2007. He was visiting scientist to

Massachusetts Institute of Technology and visiting faculty to Stanford University. He is a Fellow of ASME. He is a recipient of Abdul Kalam Technology Innovation National Fellowship of INAE. He is also recipient of IIT Delhi's K. L. Chopra Faculty Research Award in Applied Research category in its inaugural year. He has been conferred with of 2005 Vasvik Industrial Research Award.

INAE Annual Convention 2020

The INAE Annual Convention 2020 will be held Online during December 21-22, 2020 due to the unprecedented circumstances all over the world on account of COVID pandemic which prevent conduct of a physical Annual Convention. This is the first time that the Annual Convention of INAE is being held online. However, the programme would be fairly similar to that of the normal Annual Convention held each year. The Annual Convention will be preceded by the INAE Governing Council Meeting being held online on December 19, 2020. The Minute to Minute Programme of the Annual Convention is being formulated which will be forwarded to the Fellowship, Young Associates and other invitees along with the invitation for participation well in advance before the Convention. The following guidelines have been planned for conduct of the event.

(a) Day 1 would commence with the Inaugural Session which would feature the following Lighting of Lamp; Welcome; Presidential Address; Address by the Chief Guest; Induction of Fellows in the Special Category and Vote of Thanks.
(b) The Grand Award Function be held post lunch on Day 1 wherein presentation of Life Time Contribution Awards in Engineering; Prof Jai Krishna and Prof SN Mitra Memorial Awards; Outstanding Teachers Award and Woman Engineer of the Year Award would be carried out.
(c) The INAE Awards Function would also be held on Day 1, wherein the certificates, photographs etc. of awardees of INAE Young Entrepreneur Award, INAE Young Engineer Award and Innovative Student Projects Award shall be flashed and presented.
(d) The lectures by the Life Time Contribution Awardees in Engineering and Prof Jai Krishna and Prof SN Mitra Memorial Awardees and Outstanding Teachers Awardees be scheduled at a later date in December/January 2021 through the Webinar Platform and that the awardees may be requested to give an acceptance speech only in the Grand Award Function.
(e) During the Grand Award Function, the Citation, photograph etc. of the awardees will be flashed and acceptance speech shall be obtained beforehand. The citations of awardees will be read out as per practice.
(f) The Annual General Meeting (AGM) of Fellows to include the induction of Fellows and Young Associates be held on Day 2.
(g) The Newly inducted Fellows and Foreign Fellows along with Fellows/Foreign Fellows who have yet not been inducted would submit their scanned signatures prior to the Annual Convention and the signature would be digitally affixed to the electronic version of the induction register at the appropriate position.
(h) 10-minute talks, 3-4 per session, over next 5-6 INAE Webinar series will be planned for the Newly Inducted Fellows; Young Associates during the Year; Women Engineer Awardees; INAE Young Engineer Awardees and INAE Young Entrepreneur Award winners early in the year 2021.

All preparations for online conduct of the INAE Annual Convention 2020 are ongoing and intimation and invitations for the convention shall be issued well in advance to the Fellows/**Foreign Fellows**, Young Associates and other invitees along with the Block Programme to facilitate their registration and participation in the event.

Transactions of the Indian National Academy of Engineering, An International Journal of Engineering and Technology

INAE had launched a quarterly journal "INAE Letters" published by M/s Springer in the year 2016. The objective of the journal is to provide a medium for rapid publication of new research results and invited short review articles across different domains of engineering science and technology. In the year 2020 the title of the Journal has been changed to **"Transactions of Indian National Academy of Engineering – An International Journal of Engineering and Technology**" and has become a full-fledged journal to include full Research Papers and Review Articles besides short communications.

The Transactions of INAE publishes original research papers, contributed and invited reviews on the topics related to Civil Engineering, Computer Engineering and Information Technology, Mechanical Engineering, Chemical Engineering, Electrical Engineering, Electronics and Communication Engineering, Aerospace Engineering, Mining, Metallurgical and Materials Engineering, Energy Engineering, Industrial Engineering, Interdisciplinary Engineering, Nano Science and Technology, and related fields such as applied Mathematics, Applied Physics, Applied Chemistry and computational Biology.

The latest issue of the **Transactions of the Indian National Academy of Engineering-Volume 5, Issue 3, September 2020** has been brought out. There are 15 articles in this issue.
The contents of the September 2020 issue are given below.

1. **Review Article**:

A Way Forward in Waste Management of Red Mud/Bauxite Residue in Building and Construction Industry

- Suchita Rai
- Sneha Bahadure
- A. Agnihotri

2. **Review Article:**

Managing Water–Energy–Food Security Nexus Under Changing Climate: Implementation Challenges and Opportunities in India

- Narendra K. Tyagi

3. **Original Article:**

Compressive Flow Behaviour and Deformation Instabilities of Fe-Mn-Al-Ni-C Lightweight Duplex Steel

- Yahya H. Mozumder
- K. Arun Babu
- Sumantra Mandal

4. **Original Article:**

Scalable Synthesis and Kinetic Studies of Carbon Coated Sodium Titanate: A Promising Ultra-low Voltage Anode for Sodium Ion Battery

- P. Laxman Mani Kanta
- M. Venkatesh

- R. Gopalan

5. **Original Article**:

Modification of Wet Granulation Process During Iron Ore Sintering

- V. Suresh
- C. Sarkar
- S. Chakraborty
- Content type:

6. **Original Article:**

Microscopic Laws vs. Macroscopic Laws: Perspectives from Kinetic Theory and Hydrodynamics

- Mahendra K. Verma

7. **Original Article:**

Modeling and Optimisation of Spiral Concentrator for Beneficiation of Iron Ore Slimes from Kirandul, India

- G. V. Rao
- Basant Rath
- S. K. Chaurasiya

8. **Original Article:**

MOXA: A Deep Learning Based Unmanned Approach For Real-Time Monitoring of People Wearing Medical Masks

- Biparnak Roy
- Subhadip Nandy
- Tamodip Das

9. **Original Article**:

Structural Life Management in a Combat Aircraft

- Prakash D. Mangalgiri
- A. R. Upadhya

10. **Original Article:**

Water Quality and Planktonic Composition of River Henwal (India) Using Comprehensive Pollution Index and Biotic-Indices

- Gagan Matta
- Avinash Kumar
- Ashwani K. Tiwari

11. **Original Article:**

Comprehensive Assessment of Low Cycle Fatigue Behavior of Nickel-Base Superalloy Superni 263 in the Range 298–1023 K

- Jhansi Jadav
- K. V. Rajulapati
- Kartik Prasad

12. **Original Article**:

A Study on High-Grade Iron ore Beneficiation to Reduce Alumina for Enhanced Blast Furnace Productivity

- Bhawesh Chandra Jha
- Anand Sharma
- Jyotirmaya Sahoo

13. **Original Article:**

Simulation and Experimental Validation of EBW Studies in Austenitic Stainless Steel AISI-321

- A. P. Anupamadev
- V. Anil Kumar
- Ravi Ranjan Kumar

14. **Case Study:**

A Case Study on Sustainable Iron Ore Tailing Management Using Paste Technology

- Anand Sharma
- Bhawesh Chandra Jha
- Amrutanshu Das

15. **Case Study**:

Characterization and Qualification of LPBF Additively Manufactured AISI-316L Stainless Steel Brackets for Aerospace Application

- P. I. Pradeep
- V. Anil Kumar
- M. Mohan

Special Issue of Transactions of the Indian National Academy of Engineering - Volume 5, Issue 2, June 2020 on "Technologies for Fighting COVID-19"

The Special Issue of Transactions of the Indian National Academy of Engineering - Volume 5, Issue 2, June 2020 on "Technologies for Fighting COVID-19" was published and is available on INAE website, as well as in open access domain on Springer website. The articles in the issue may

be downloaded either through the log in facility provided to INAE Fellows or by copying the link given below in your internet browser.

https://link.springer.com/journal/41403/5/2

The contents of the Special Issue are given below:

1. **Editorial**

Foreword by President of INAE
Sanak Mishra Page 89

2. **PREFACE**

PREFACE on the Special Issue 'Technologies for Fighting COVID-19'
Amit Agrawal, Shiv Govind Singh Pages 91-95

3. **Technical Note**

Opportunities, Challenges and Directions in Science and Technology for Tackling COVID-19
Appa Rao Podile, Anirban Basu Pages 97-101

4. **Original Article**

COVID-19 Pandemic: Power Law Spread and Flattening of the Curve
Mahendra K. Verma, et al Pages 103-108

5. **Original Article**

Temporal Dynamics of COVID-19 Outbreak and Future Projections: A Data-Driven Approach
Rajesh Ranjan Pages 109-115

6. **Original Article**

Epidemiologically and Socio-economically Optimal Policies via Bayesian Optimization
Amit Chandak, Debojyoti Dey, et al Pages 117-127

7. **Original Article**

Optimising Lockdown Policies for Epidemic Control using Reinforcement Learning
Harshad Khadilkar, et al Pages 129-132

8. **Original Article**

A Predictive Model for the Evolution of COVID-19
Rajneesh Bhardwaj Pages 133-140

9. **Original Article**

Predicting the Spread of COVID-19 Using SIRSIR Model Augmented to Incorporate Quarantine and Testing
Nikhil Anand, A. Sabarinath, et al Pages 141-148

H. Hirani Pages 379-384

46. Original Article

Affordable, Compact and Infection-Free BiPAP Machine
Gaurav Pal Singh et al Pages 385-391

47. Original Article

Leveraging Wettability Engineering to Develop Three-Layer DIY Face Masks From Low-Cost Materials
Sourav Sarkar, Achintya Mukhopadhyay et al Pages 393-398

48. Review Article

Chloroquine: A Potential Drug in the COVID-19 Scenario
Ranjana Singh, Viji Vijayan Pages 399-410

49. Original Article

En route to Peptide Therapeutics for COVID 19: Harnessing Potential Antigenic Mimicry Between Viral and Human Proteins
Maya Madhavan et al Pages 411-415

50. Review Article

An Overview of Coronavirus COVID-19 with their Pathogenesis and Risk Assessment of the Disease Utilizing Positive Predictive Value of the Clinical and Laboratory Data
Tapan Krishna Biswas, Malabika Biswas et al Pages 417-427

51. Original Article

Conceptual Design of a Body Bag for Preventing Infections and Safe Disposal of Deceased from COVID-19 Virus
Mayank Patel, Shubham Khatri et al Pages 429-435

Submission of high-quality research/review papers are invited from the Fellowship, Young Associates and their colleagues. Guidelines for submission of papers are available on Springer website and through log in facility provided to INAE Fellows.

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Academia Industry Interaction

AICTE-INAE Distinguished Visiting Professorship Scheme

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

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

Prof. KG Narayankhedkar, FNAE Professor (Mech Engg.) and Dean (Planning), IIT Bombay; Director, VJIT, Mumbai	Vishwakarma Institute of Technology, Pune Oct 9-11, 2019 Nov 20-22, 2019 Feb 10-12, 2020	Delivered lectures on "Life Long Learning: Attainment of the PO-12", "Planning of the M.Tech. Projects" and "Cryogenics for Space Applications". Delivered lectures on "Cryogenic Insulation", "Lab Manuals" and "Industry 4.0-Curriculum Reforms" Delivered lectures on "Exergy Analysis for Thermal Systems", "HOTs- Questions for PG Students" and "Effective Implementation of PG Projects According to the feedback received from the Institute, the Scheme is very useful and it is giving lot of advantage in terms of inputs for the syllabus and implementation, with practical approach, which is essentially due to the wide experience of the visiting professor. He has given inputs for improving research culture and implementation of activities such as addressing complex engineering problems using modern tools leading to multiple solutions.
Prof. KG Narayankhedkar, FNAE Professor (Mech Engg.) and Dean (Planning), IIT Bombay; Director, VJIT, Mumbai	Atharva College of Engineering, Malad, Mumbai Sept 18-20, 2019 Nov 4-6, 2019	Delivered lectures on "Program Specific Objectives (PSOs)", "Role of Mini Projects and BE projects" and "Individual Quick Freezing - for Quality Freezing Preservation" Delivered lectures on "Setting a Graded Question Paper", "UG Projects - Planning, Goal

	Feb 26-28, 2020	Setting and Execution" and "Air-conditioning System Design - Controls and Instrumentation" Delivered lectures on "Attainment of Higher Order Program Objectives", Examples related to Second Law of Thermodynamics (Complex Engineering Problems)" and "Blooms Taxonomy-Implementation" According to the feedback received from the College the Scheme is very useful to them particularly due to involvement of the Senior distinguished visiting Professor. The interaction is helping in improving the quality of teaching-learning process. It was expressed that the scheme is one of the most relevant schemes for Academic Excellence and is welcome by colleges. This gives an opportunity to the students and faculty of the college to get in touch with the DVP any time. Certainly, the scheme has an impact. Impact is positive and such schemes are necessary.
Prof MR Madhav, FNAE Professor Emeritus and Visiting Professor, IIT Hyderabad and JNTUH	Vallurupalli Nageswara Rao Vignana Jyothi Institute of Engineering and Technology, Hyderabad Feb 3-5, 2020	Delivered lectures on "How to Write a Technical Paper", "Sustainable Development: Geotechnical Alternatives" and "Back fill Soil Interaction: Analysis" According to the feedback received from the college, the lectures were well received by students and faculty.

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International/National Conferences/Seminars being organized by IITs/other Institutions

List of International/ National Conferences/Seminars being held in the month of October 2020:

International Conference on Communication, Circuits, and Systems (iC3S 2020) Conference on 14th to 16th October 2020 at Bhubaneswar, Odisha
https://conferencealerts.com/show-event?id=226530

5th IEEE International Conference on Computing, Communication & Security (ICCCS-2020) Conference on 14th to 16th October 2020 at Patna, Bihar
https://conferencealerts.com/show-event?id=224280

International Conference on Communication, Computing and Electronics Systems (ICCCES 2020) Conference on 21st to 22nd October 2020 at Coimbatore
https://conferencealerts.com/show-event?id=226907

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

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Honours and Awards

1.	Dr. B N Suresh, FNAE, Chancellor of Indian Institute of Space Science and Technology and Dr. K Sivan, FNAE, Secretary DOS / Chairman of ISRO were honoured with the prestigious 2020 'IEEE Simon Ramo medal' for their outstanding leadership in developing national space program of India and for pioneering space technology. This award is for their exemplary work in the field of systems engineering. The award consists of a medal, citation and a cash prize. The ceremony was held on September 29, 2020 at ISRO headquarters in Bengaluru. The ceremony was attended by Padma Vibhushan Dr. VK Aatre, former Chairman of DRDO; Padma Shri R.M. Vasagam former Project Director, APPLE Satellite; Dr. Surendra Pal, FNAE, former Vice Chancellor, Defence Institute of Advanced Technology Pune; Prof. H P Kincha, Chairman-Karnataka State Innovation Council; Prof. Govindan Rangarajan, Director of IISc; Prof. Anurag Kumar, FNAE former Director IISc; Prof. Dr. Ramakrishna Kappagantu, former IEEE Region 10 Director; Prof. Debabrata Das, IIITB; Prof. Radhakanth Padhi, IISc; Mr. Puneet Kumar, Chair- IEEE Bangalore Section and Secretary IEEE India Council and Mr. Harish Mysore, Sr. Director-IEEE India Operations and other ISRO dignitaries. The IEEE Simon Ramo Medal was established by the IEEE Board of Directors in 1982. It is named in the honour of the distinguished engineering contributions of Dr. Simon Ramo, former Vice Chairman of the Board and Chairman of the Executive Committee of Thompson Ramo Wooldridge (TRW), Inc. Dr B N Suresh and Dr. K Sivan are the only Indian recipients of this prestigious award till date.

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News of Fellows

1.	Dr Sanak Mishra, FNAE, President, INAE and Formerly Managing Director, Rourkela Steel Plant and Director, Steel Authority of India Ltd. (SAIL); Vice-President, ArcelorMittal and CEO India Projects; Secretary General, Indian Steel Association; President, Indian Institute of Metals has been selected as a member of the Jury panel for GITA Global Innovation Excellence Awards by the Global Innovation & Technology Alliance (GITA). The GITA Global Innovation Excellence Award was instituted with the objective of recognizing Companies who have developed path breaking technologies through global partnerships with industry and academia, contributing to a path leading to self-sustenance and development. Dr Sanak Mishra has also been nominated as Member of the Research Council (RC) for the CSIR- National Physical Laboratory (CSIR-NPL), New Delhi constituted with the objective of providing advice on the formulation of R&D programmes and future directions of activities of the laboratory keeping in view the CSIR mandate, national priorities and opportunity areas.
2.	Prof Prem Vrat, FNAE, Former Founder Director, IIT Roorkee; Former VC, UPTU, Lucknow; Former Professor & Director-in-Incharge, IIT Delhi; Former Vice-Chancellor and Professor of Eminence, ITM University, Gurgaon has been nominated as the Chairperson of the Board of Governors (BoG) of Indian Institute of Technology (Indian School of Mines) Dhanbad by the Hon'ble President of India, in his capacity as the Visitor of the Indian Institute of Technology (ISM) Dhanbad (Jharkhand) for a period of three years w.e.f. 25.08.2020.
3.	Dr U Kamachi Mudali, FNAE, formerly Distinguished Scientist and Chairman & Chief Executive, Heavy Water Board, Department of Atomic Energy, Mumbai and Former Director, Materials Chemistry and Metal Fuel Cycle Group, IGCAR, Kalpakkam & Former Associate Director, Corrosion Science & Technology Group and Materials Process & Equipment Development Group, IGCAR, Kalpakkam was felicitated for his 36 years of dedicated service towards nuclear industry and corrosion control technologies by his friends, colleagues and students on September 29, 2020 over WebEx. The programme was attended by about 270 colleagues/students/associates of Dr U Kamachi Mudali. Dr Anil Kakodkar, FNAE was the Chief Guest and he officially released the e-book entitled "A Treatise on Corrosion Science, Engineering and Technology" a commemorative volume brought out in honour of Dr U Kamachi Mudali. The e-copy of the book may be downloaded from the link given below. https://1drv.ms/b/s!AiJosityWbm3iM1VuaQvbrbbKAR0_Q?e=CZD4We

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News of Young Associates

1	Dr Amol A Kulkarni, Scientist, National Chemical Laboratory (NCL), Pune and Associate Editor, Transactions of Indian National Academy of Engineering - An International Journal of Engineering and Technology, was awarded the Shanti Swarup Bhatnagar Prize for the year 2020 in Engineering Sciences Category.

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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/pages/Indian-National-Academy-of-Engineering/714509531987607?ref=hl

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

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Obituaries

Professor Nitindra Nath Som
(January 29, 1941 – July 31, 2020)

Prof Nitindra Nath Som, born on 29 January 1941 in the city of Kolkata, breathed his last in the afternoon of Friday the 31st July, 2020, fighting COVID-19. His untimely demise has come as a terrible shock to his family and thousands of his friends, admirers and colleagues across the globe. Nitin, as I called him, was a rare combination of an outstanding teacher, a committed researcher and a much sought after practitioner in the field of Geotechnical Engineering. After obtaining his Ph.D. degree in Soil Mechanics from the Imperial College, London in 1968, and after having a brief stint at IIT Delhi, he joined his alma mater -the Jadavpur University- in 1969 and made it his Karm Bhumi for over four decades. By sheer hard work, he naturally rose to the positions of Professor and Head of the Civil Engineering Department; Dean of the Faculty of Engineering and Technology; Founder President of Society of Civil Engineers, and President of Geotechnical Study Circle. In all his endeavours, he always tried to give nothing less than his elemental best. The long list of contributions bear testimony to this fact.

It will, however, be a huge mistake for us to judge him by the size of contributions or merely in terms of the visible artefacts of his accomplishments. It is true that he left his indelible mark of professional excellence on many of the flagship projects such as Kolkata Metro, Delhi Metro, Dhaka Metro and the Golden Quadrilateral project. It is equally true that Nitin will always remain a visible face to the Indian Geotechnical Society as its Honorary Fellow; President (1999-2000); Annual IGS Speaker (1998); a Kueckelmann Awardee (2001); or the one who represented IGS at the ISSMGE Council meeting in Osaka (2005) and later on so astutely steered the affairs of 13th Asian Regional Conference in 2007. It was indeed a proud moment for the IGS as the event revived the grand old memories of the historic 13th ICSMFE (1994) and the 1st ARC (1960) and the 5th ARC (1975). Likewise, the research scientists are most likely to routinely judge him by the quality of his papers, reports and publications in the fields of Foundation, Highway and Geo-environment engineering in general and in the areas of Quality Geotechnical Investigation, Slope stability, Ground Improvement, and Underground construction in particular.

In my considered view, his real worth and weight of contributions will continue to elude our imagination so long as we do not credit him for grooming an army of Geotechnical Engineers in India with an insightful and high quality Geotechnical Engineering education. Someone has rightly said that whatever a teacher writes on the black board of the lives of his students, good or bad, can never be erased. Nitin was a teacher par excellence and I have not even a shadow of doubt that the influence of his teachings would last through generations! Many of his students are already good teachers in their own right, and can be trusted to keep the flame of quality Geotechnical education burning! The beauty of his contribution also lies in the fact that he strived hard to find a down to earth connection between the real life field problems on one hand and the best in science and technology and the development of codes and standards to shape the Indian Engineering Practice on the other hand. His tenure as the Chairman of the Soil and Foundation Engineering Sectional Committee of Bureau of Indian Standards will be remembered in this light. He was elected as a Fellow of Indian National Academy of Engineering in 2003.

Prof Som himself was singularly fortunate in learning Soil Mechanics straight from the best known teachers of his times. I first met him in 1967 when I too joined Imperial College as a Royal Commission scholar for my Ph.D . With professional giants such as A.W. Skempton; A.W. Bishop; John Hutchinson, Norbert Morgenstern, Peter Vaughan, Noel Simons and Nicholas Ambraseys on the faculty and Laurits Bjerrum, D.J. Henkel, A.D.M. Penman and R.E. Gibson as the visiting faculty, we could not have asked for more!

My interaction with Nitin spanning over 53 years was most intense in matters connected with studies on the Indian Landslides. He was part of the team that prepared updated glossary on the risk of landslides presented at the 12 IAEG Congress in Turin in September 2014. The updated Varnes Classification of Landslides was subsequently published in the Journal of Landslides in 2014. The same year he made significant contributions to the two National Level Roundtable Meetings on Landslide Disaster Mitigation organized by me under the aegis of Indian National Academy of Engineering in May and November 2014. During my continuing tenure with the work of the Joint Technical Committee on Natural Slopes and Landslides under the aegis of the Federation of the International Geo-engineering Societies, the inputs received for him, from time to time, were most useful. Despite pressure on his time, at my request, he always contributed papers and made presentations at many landmark events organised under the aegis of INAE, NDMA, NIDM and VIT University, advancing Geotechnical Engineering Hill Slope Stability and Landslides.

On 2 June 2008, upon having the sad news of the demise of Prof Peter Vaughan, who was our teacher at Imperial College, Prof Som, wrote "He was the doyen of classical soil mechanics who carried the thoughts and ideas of the sixties and seventies very fruitfully to practical engineering applications. My fond memories of Peter at Imperial College will have a special place in my heart." Today, when Professor Som himself is no more, let us singly and collectively say that he too will have a very special place in our hearts!

May God bless his soul to Rest in Peace

Written by: Dr R.K. Bhandari (A Close friend of Professor Nitin Som)

Dr Sekhar Basu
(September 20, 1952 – September 24, 2020)

Dr. Sekhar Basu, a renowned nuclear scientist, was Chairman, Atomic Energy Commission and Secretary to the Government of India, Department of Atomic Energy (DAE) from October 2015 to September 2018. Prior to his assumption of charge as Secretary, DAE, he was holding the position of Director, Bhabha Atomic Research Centre (BARC) from June 2012 to October 2015. Earlier he worked as Project Director of Nuclear Submarine Programme and later as the Chief Executive of the Nuclear Recycle Board in the same institute. Dr. Basu, a dynamic engineer of exceptional abilities, played major role in establishing India as a lead country in various domains of nuclear science and engineering.

Dr. Basu, born in 1952 at Muzaffarpur in Bihar, did his schooling from Ballygunge Government School, Kolkata and graduated in Mechanical Engineering from VJTI, University of Mumbai in 1974. After completion of one year of BARC Training School programme in nuclear science and engineering, he took up the responsibility of the development of nuclear submarine propulsion plant and was responsible for achieving success in the same. Subsequently, he took up activities related to India's nuclear recycle plants. Under his leadership, the plant operations were streamlined and based on operational experience he took up a very major challenge of design & construction of Integrated Nuclear Recycle Plant, which is first of its kind in India. His untiring efforts in this field have brought perfection in technology and given major boost to the programme.

Dr Basu played key roles in advancing nuclear science and engineering in India. Dr. Basu accelerated the pace of Nuclear Power deployment, Uranium Exploration and Mining, Health-care and Mega science projects. He played a key role in obtaining government approvals for Ten Pressurized Heavy Water Reactors (PHWRs) and Two Pressurized Water Reactors (PWRs). This is a major boost towards increase of installed capacity of nuclear power stations. Under his leadership, the nuclear

reactor powering India's first nuclear-powered submarine, INS Arihant, was developed. The reactor took five decades to make and the involvement of a half lakh people, he once told an audience at a book launch.

Dr. Basu was an extremely competent technologist with an ability to integrate multi-disciplinary activities and develop multiple state of the art technology systems. He was awarded Padma Shri by the Government of India in 2014. One of the last projects in which he had taken keen interest was to develop the technology of cyclotron for medical isotope production. In 2014, he was honoured with the Padma Shri.

Dr. Basu passed away in the early hours of 24th September 2020 in a hospital in Kolkata. Dr. Basu was undergoing treatment for COVID-19. Shri Narendra Modi, Hon'ble Prime Minister tweeted his condolences and said "I join the atomic energy fraternity in grieving the passing away of Dr Sekhar Basu, a renowned nuclear scientist who played a key role in establishing India as a lead country in nuclear science and engineering. Our thoughts and prayers are with his family and friends. Om Shanti!"

May God bless his soul to Rest in Peace

Dr PL Narasimhan
(August 13, 1940 – October 1, 2020)

Dr PL Narasimhan, FNAE, TVS Motors Chair Professor, Department of Industrial Engineering and Management, Indian Institute of Technology Kharagpur born on August 13, 1940 passed away on October 1, 2020. He was Formerly Vice-President (R&D), Lakshmi Machine Works Ltd wherein he made significant contributions in collaborative new product development with a view to build up the technological base to bring competitive and state-of-art textile machineries to compete in the market. The development of these machines required in-depth knowledge of Mechanical engineering, textile Engineering, Metallurgy, Pneumatics and electronics etc. By the new development process, excellent quality products were brought out. All the machines developed were controlled by invertors and process controllers with sensing devices to give the feedback and to exercise control. Some of the notable achievements under the leadership of Dr PL Narasimhan include development of a new ring which enabled the ring spinning machines to go to higher speeds of about 18000rpm which led to higher productivity. He was also responsible for developing an improved carding machine for nearly double the production with the same quality level. He also realized a new combing machine for giving nearly double the production with high quality standard while overcoming problems of vibrations, alignment of the machines for high speed, modular construction and control of intricate movements. All the above machines were patented.

At IIT Kharagpur, Dr PL Narasimhan motivated the final year BTech students to creative ideas. He divided them in groups and encouraged them to come up with new ideas and create physical models based on the ideas. Many creative ideas and models have been developed. He made significant contributions in teaching and research at IIT Kharagpur and encouraged students to do creative and intellectual work which was appreciated by all the students. His demise on October 1, 2020 was condoled by students and faculty of IIT Kharagpur.

May God bless his soul to Rest in Peace

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Engineering and Technology Updates

Civil Engineering

1. Green Roads for India – "Initiative Towards Swatchh Bharat"

Ammann India launched a forum with Indian Road fraternity to work on major aspects of "Sustainable Asphalt Pavement Technologies." The ACC 90 CounterMix asphalt plant is the perfect combination of Energy saving, minimum Carbon footprints, and state-of-the-art pollution control system to meet the stringent pollution norms. The success of Ammann Asphalt-Mixing Plants is driven by innovation, backed up with massive investments in R&D, which play a vital role in developing a sustainable, cost effective solution to the road building industry. RD Infratech Pvt Ltd recently purchased an Ammann ACC 90 CounterMix Asphalt-Mixing Plant. "It is an environment friendly plant that utilizes green technology," said Mr. Jitendra Yadav, Director of the company. Mr. Yadav said the plant meets the guidelines of National Green Tribunal (NGT) and Central Pollution Control Board (CPCB). "There are stiff pollution norms," he said. "This is the only plant that has met NGT conditions." The plant produces asphalt mix for the Noida-Greater Noida Expressway, which connects Noida, Uttar Pradesh to the new suburb of Greater Noida. It is also being put to work on other sector roads. Recycled plastics are used in some of the mixes manufactured for the project. The ACC 90 CounterMix, which produces about 600 tons per day, is a counter flow asphalt drum-mix plant known for being productive and environmentally friendly. It combines the simplicity of existing continuous drum-mix plants with the added efficiency achieved through counter flow technology. Lesser energy requirements for heating lead to reduced emissions. It also produces mix at a lower cost than traditional parallel flow drum-mix plants and can easily incorporate recycled asphalt (RAP) and other additives. The key green features, particularly lower emissions and recycling capabilities were a perfect match. Overall, the ACC 90 CounterMix is a cost-saver. The plant is fuel efficient and consumes less when compared to other plants.

Source https://info.cecr.in/construction-equipments/green-roads-for-india-initiative-towards-swatchh-bharat

2. A New Neural Network Could Help Computers Code Themselves

Computer programming has never been easy. The first coders wrote programs out by hand, scrawling symbols onto graph paper before converting them into large stacks of punched cards that could be processed by the computer. One mark out of place and the whole thing might have to be redone. Nowadays coders use an array of powerful tools that automate much of the job, from catching errors as you type to testing the code before it's deployed. But in other ways, little has changed. One silly mistake can still crash a whole piece of software. And as systems get more and more complex, tracking down these bugs gets more and more difficult. "It can sometimes take teams of coders days to fix a single bug," says Justin Gottschlich, director of the machine programming research group at Intel. That's why some people think we should just get machines to program themselves. Automated code generation has been a hot research topic for a number of years. Microsoft is building basic code generation into its widely used software development tools, Facebook has made a system called Aroma that autocompletes small programs, and DeepMind has developed a neural network that can come up with more efficient versions of simple algorithms than those devised by humans. Even OpenAI's GPT-3 language model can churn out simple pieces of code, such as web page layouts, from natural-language prompts. Gottschlich and his colleagues call this machine programming. Working with a team from Intel, MIT and the Georgia Institute of Technology in Atlanta, he has developed a system called Machine Inferred Code Similarity, or MISIM, that can extract the meaning of a piece of code—what the code is telling the computer to do—in much the same way as natural-language processing (NLP) systems can read a paragraph written in English. MISIM can then suggest other ways the code might be written, offering corrections and ways to make it faster or more efficient. The tool's ability to understand what a program is trying to do lets it identify other programs that do similar things. In theory, this approach could be used by machines that wrote their own software, drawing on a patchwork of pre-existing programs with minimal human oversight or input. MISIM works by comparing snippets of code with millions of other programs it has already seen, taken from a large number of online repositories. First it translates the code into a form that captures what it does but ignores how it is written, because two programs written in very different ways sometimes do the same thing. MISIM then uses a neural network to find other code that has a similar meaning. In a preprint, Gottschlich and his colleagues report that MISIM is 40 times more accurate than previous systems that try to do this, including Aroma. MISIM is an exciting step forward, says Veselin Raychev, CTO at the Swiss-based company DeepCode, whose bug-catching tools—among the most advanced on the market—use neural networks trained on millions of programs to suggest improvements to coders as they write. But machine learning is still not great at predicting whether or not something is a bug, says Raychev. That's because it is hard to teach a neural network what is or isn't an error unless it has been labeled as such by a human. There's a lot of interesting research being done with deep neural networks and bug fixing, he says, "but practically they're not there yet, by a very big margin." Typically AI bug-catching tools produce lots of false positives, he says. MISIM gets around this by using machine learning to spot similarities between programs rather than identifying bugs directly. By comparing a new program with an existing piece of software that is known to be correct, it can alert the coder to important differences that could be errors. Intel plans to use the tool as a code recommendation system for developers in-house, suggesting alternative ways to write code that are faster or more efficient. But because MISIM is not tied to the syntax of a specific program, there is much more it could potentially do. For example, it could be used to translate code written in an old language like COBOL into a more modern language like Python. Ultimately, Gottschlich thinks this idea could be applied to natural language. Combined with NLP, the ability to work with the meaning of code separately from its textual representation could one day let people write software simply by describing what they want to do in words, he says.

Source https://www.technologyreview.com/2020/07/29/1005768/neural-network-similarities-between-programs-help-computers-code-themselves-ai-intel

3. Promising New Research Identifies Novel Approach for Controlling Defects In 3D Printing

With its ability to yield parts with complex shapes and minimal waste, additive manufacturing has the potential to revolutionize the production of metallic components. That potential, however, is currently limited by one critical challenge: controlling defects in the process that can compromise the performance of 3D-printed materials. New research points to a possible breakthrough solution: Use temperature data at the time of production to predict the formation of subsurface defects so they can be addressed right then and there. A team of researchers at the U.S. Department of Energy's (DOE) Argonne National Laboratory, together with a colleague now at Texas A&M University, discovered the possibility. "Ultimately you would be able to print something and collect temperature data at the source and you could see if there were some abnormalities, and then fix them or start over," said Aaron Greco, group manager for Argonne's Interfacial Mechanics & Materials group in the Applied Materials Division (AMD) and a study author. "That's the big-picture goal." For their research, the scientists used the extremely bright, high-powered X-rays at beamline 32-ID-B at Argonne's Advanced Photon Source (APS), a Department of Energy Office of Science User Facility. They designed an experimental rig that allowed them to capture temperature data from a standard infrared camera viewing the printing process from above while they simultaneously used an X-ray beam taking a side-view to identify if porosity was forming below the surface. Porosity refers to tiny, often microscopic "voids" that can occur during the laser printing process and that make a component prone to cracking and other failures. According to Noah Paulson, a computational materials scientist in the Applied Materials division and lead author on the paper, this work showed that there is in fact a correlation between surface temperature and porosity formation below. "Having the top and side views at the same time is really powerful. With the side view, which is what is truly unique here with the APS setup, we could see that under certain processing conditions based on different time and temperature combinations porosity forms as the laser passes over," Paulson said. For example, it was observed that thermal histories where the peak temperature is low and followed by a steady decline are likely to be correlated with low porosity. In contrast, thermal histories that start high, dip, and then later increase are more likely to indicate large porosity. The scientists used machine learning algorithms to make sense out of the complex data and predict the formation of porosity from the thermal history. Paulson said that in comparison to the tools developed by tech giants that use millions of data points, this effort had to make do with a couple hundred. While 3D printers typically come equipped with infrared cameras, the cost and complexity make it impossible to equip a commercial machine with the kind of X-ray technology that exists at the APS, which is one of the most powerful X-ray light sources in the world. But by designing a methodology to observe systems that already exist in 3D printers, that wouldn't be necessary. The ability to identify and correct defects at the time of printing would have important ramifications for the entire additive manufacturing industry because it would eliminate the need for costly and time-consuming inspections of each mass-produced component. In traditional manufacturing, the consistency of the process makes it unnecessary to scan every metallic component coming off of the production line. This effort is made all the more urgent in recognizing one of the key advantages that additive manufacturing has over traditional manufacturing.

Source https://www.sciencedaily.com/releases/2020/08/200805181730.htm

4. How to Harness the Power of Biosolids to Make Hydrogen

Researchers have used biosolids to produce hydrogen from wastewater, in new technology that supports the comprehensive recycling of one of humanity's unlimited resources -- sewage.The innovation focuses on the advanced upcycling of biosolids and biogas, by-products of the wastewater treatment process. Developed by researchers at RMIT University in Melbourne, Australia, the patented technology uses a special material derived from biosolids to spark chemical reactions for producing hydrogen from biogas. The approach means all the materials needed for hydrogen production could be sourced on-site at a wastewater treatment plant, without the need for expensive catalysts. The method also traps the carbon found in biosolids and biogas, which could in future enable a near zero-emission wastewater sector. Lead researcher Associate Professor Kalpit Shah said existing commercial methods for producing hydrogen were emission and capital-intensive, and relied heavily on natural gas. "Our alternative technology offers a sustainable, cost-effective, renewable and efficient approach to hydrogen production," said Shah, Deputy Director (Academic) of the ARC Training Centre for Transformation of Australia's Biosolids Resource at RMIT. "To enable the transition to a circular economy, we need technology that enables us to squeeze the full value from resources that would ordinarily go to waste. "Our new technology for making hydrogen relies on waste materials that are essentially in unlimited supply. "By harnessing the power of biosolids to produce a fully clean fuel from biogas -- while simultaneously preventing greenhouse gas emissions -- we can deliver a true environmental and economic win." Biosolids are commonly used as fertiliser and soil amendment in agriculture, but around 30% of the world's biosolids resource is stockpiled or sent to landfill, creating an environmental challenge. In the new method, biosolids are first converted to biochar -- a carbon-rich form of charcoal used to improve soil health.The biosolids-derived biochar contains some heavy metals, which makes it an ideal catalyst for producing hydrogen out of biogas. As part of the experimental bench-scale study, researchers tested the process with a methane-rich gas that resembles biogas. They showed the biochar made from biosolids is highly effective for decomposing the gas into its component elements -- hydrogen and carbon. The decomposition process can also be conducted in a specially designed and hyper-efficient reactor developed and patented by RMIT, which can produce both hydrogen and a high-value biochar that is coated with carbon nanomaterials. By converting the carbon found in biogas and biosolids into advanced carbon nanomaterials, their method can also capture and sequester the greenhouse gas to prevent its release into the atmosphere. The carbon nanomaterial-coated biochar produced through the novel technique has a range of potential applications including environmental remediation, boosting agricultural soils and energy storage. Shah said the unique reactor developed by the RMIT School of Engineering team was at the heart of this innovative recycling approach. As well as being used in wastewater treatment, the novel reactor has potential applications in the biomass, plastics and coating industries.

Source https://www.sciencedaily.com/releases/2020/09/200914095901.htm

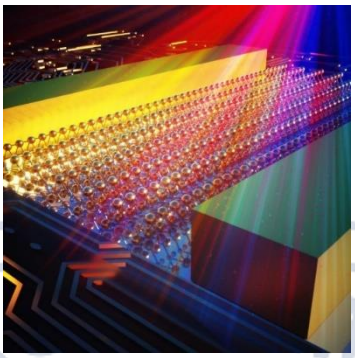
Electrical Engineering

5. World's Smallest Ultrasound Detector Created

Researchers at Helmholtz Zentrum München and the Technical University of Munich (TUM) have developed the world's smallest ultrasound detector. It is based on miniaturized photonic circuits on top of a silicon chip. With a size 100 times smaller than an average human hair, the new detector can visualize features that are much smaller than previously possible, leading to what is known as super-resolution imaging. Since the development of medical ultrasound imaging in the 1950s, the core detection technology of ultrasound waves has primarily focused on using piezoelectric detectors, which convert the pressure from ultrasound waves into electric voltage. The imaging resolution achieved with ultrasound depends on the size of the piezoelectric detector employed. Reducing this size leads to higher resolution and can offer smaller, densely packed one or two dimensional ultrasound arrays with improved ability to discriminate features in the imaged tissue or material. However, further reducing the size of piezoelectric detectors impairs their sensitivity dramatically, making them unusable for practical application. Silicon photonics technology is widely used to miniaturize optical components and densely pack them on the small surface of a silicon chip. While silicon does not exhibit any piezoelectricity, its ability to confine light in dimensions smaller than the optical wavelength has already been widely exploited for the development of miniaturized photonic circuits. Researchers at Helmholtz Zentrum Munchen and TUM capitalized on the advantages of those miniaturized photonic circuits and built the world's smallest ultrasound detector: the silicon waveguide-etalon detector, or SWED. Instead of recording voltage from piezoelectric crystals, SWED monitors changes in light intensity propagating through the miniaturized photonic circuits. "This is the first time that a detector smaller than the size of a blood cell is used to detect ultrasound using the silicon photonics technology," says Rami Shnaiderman, developer of SWED. The SWED size is about half a micron (=0,0005 millimeters). This size corresponds to an area that is at least 10,000 times smaller than the smallest piezoelectric detectors employed in clinical imaging applications. The SWED is also up to 200 times smaller than the ultrasound wavelength employed, which means that it can be used to visualize features that are smaller than one micrometer, leading to what is called super-resolution imaging. As the technology capitalizes on the robustness and easy manufacturability of the silicon platform, large numbers of detectors can be produced at a small fraction of the cost of piezoelectric detectors, making mass production feasible. This is important for developing a number of different detection applications based on ultrasound waves. "We will continue to optimize every parameter of this technology -- the sensitivity, the integration of SWED in large arrays, and its implementation in hand-held devices and endoscopes," adds Shnaiderman. While the researchers are primarily aiming for applications in clinical diagnostics and basic biomedical research, industrial applications may also benefit from the new technology. The increased imaging resolution may lead to studying ultra-fine details in tissues and materials. A first line of investigation involves super-resolution optoacoustic (photoacoustic) imaging of cells and micro-vasculature in tissues, but the SWED could be also used to study fundamental properties of ultrasonic waves and their interactions with matter on a scale that was not possible before.

Source https://www.sciencedaily.com/releases/2020/09/200916154852.htm

6. World's First Photodetector That Can See All Shades of Light



Photodetectors work by converting information carried by light into an electrical signal and are used in a wide range of technologies, from gaming consoles to fiber optic communication, medical imaging, and motion detectors. Currently, photodetectors are unable to sense more than one color in the one device. This means they have remained bigger and slower than other technologies, like the silicon chip, that they integrate with. The new hyper-efficient broadband photodetector developed by researchers at RMIT University is at least 1,000 times thinner than the smallest commercially available photodetector device. In a significant leap for the technology, the prototype device can also see all shades of light between ultraviolet and near infrared, opening new opportunities to integrate electrical and optical components on the same chip. The breakthrough technology opens the door for improved biomedical imaging, advancing early detection of health issues like cancer. Study lead author, PhD researcher Vaishnavi Krishnamurthi, said in photodetection technologies, making a material thinner usually came at the expense of performance. "But we managed to engineer a device that packs a powerful punch, despite being thinner than a nanometre, which is roughly a million times smaller than the width of a pinhead," she said. As well as shrinking medical imaging equipment, the ultra-thin prototype opens possibilities for more effective motion detectors, low-light imaging and potentially faster fiber optical communication. "Smaller photodetectors in biomedical imaging equipment could lead to more accurate targeting of cancer cells during radiation therapy," Krishnamurthi said. "Shrinking the technology could also help deliver smaller, portable medical imaging systems that could be brought into remote areas with ease, compared to the bulky equipment we have today." How versatile and useful photodetectors are depends largely on three factors: their operating speed, their sensitivity to lower levels of light, and how much of the spectrum they can sense. Typically, when engineers have tried improving a photodetector's capabilities in one of those areas, at least one of the other capabilities have been diminished. Current photodetector technology relies on a stacked structure of three to four layers. The researchers from RMIT's School of Engineering scrapped the stacked model and worked out how to use a nanothin layer — just a single atom thick — on a chip. Importantly, they did this without diminishing the photodetector's speed, low-light sensitivity or visibility of the spectrum. The prototype device can interpret light ranging from deep ultraviolet to near-infrared wavelengths, making it sensitive to a broader spectrum than a human eye. And it does this over 10,000 times faster than the blink of an eye. A major challenge for the team was ensuring electronic and optical properties didn't deteriorate when the photodetector was shrunk, a technological bottleneck that had previously prevented the miniaturization of light detection technologies. Chief investigator Associate Professor Sumeet Walia said the material used, tin monosulfide, is low-cost and naturally abundant, making it attractive for electronics and optoelectronics. "The material allows the device to be extremely sensitive in low-lighting conditions, making it suitable for low-light photography across a wide light spectrum," he said. Walia said his team is now looking at industry applications for their photodetector, which can be integrated with existing technologies such as CMOS chips. "With further development, we could be looking at applications including more effective motion detection in security cameras at night and faster, more efficient data storage," he said.

Source https://scitechdaily.com/worlds-first-photodetector-that-can-see-all-shades-of-light

Aerospace Engineering

7. Gaganyaan Manned Mission Space Suits Under Production in Russia

Russian research and development enterprise Zvezda has started manufacturing of space suits and personal flight equipment for Indian cosmonauts undergoing training in Russia to be part of India's first manned space mission Gaganyaan said recently. Glavkosmos is a subsidiary of Roscosmos with which the Human Spaceflight Center (HSC) of the Indian Space Research Organisation (ISRO) has signed a contract to train the Indian astronauts. "On September 3, Indian cosmonauts who have been training for a spaceflight in Russia under the contract of Glavkosmos, visited Zvezda, where their anthropometric parameters were measured for the subsequent production of spacesuits," Glavkosmos CEO Dmitry Loskutov said. The contract also provides for the production of individual seats and custom-made couch liners, he added. The contract for the production and delivery of individual equipment kits for Indian astronauts was signed by Glavkosmos and the HSC on March 11. Four Indian Air Force fighter pilots are currently under training in Russia since February 10, and likely to be the potential candidates for Gaganyaan project. Gaganyaan, India's first manned mission to space, was planned around 2022. ISRO to Send Humanoid Vyommitra in Space Ahead of Human Spaceflight. However, ISRO has indicated that it may be delayed due to COVID-19 pandemic and the lockdown induced by it.

Source https://gadgets.ndtv.com/science/news/gaganyaan-manned-mission-space-suits-under-production-in-russia-2292095

Mining, Metallurgical and Materials Engineering

8. New Composite Material Revs Up Pursuit of Advanced Electric Vehicles

Scientists at Oak Ridge National Laboratory used new techniques to create a composite that increases the electrical current capacity of copper wires, providing a new material that can be scaled for use in ultra-efficient, power-dense electric vehicle traction motors. The research is aimed at reducing barriers to wider electric vehicle adoption, including cutting the cost of ownership and improving the performance and life of components such as electric motors and power electronics. The material can be deployed in any component that uses copper, including more efficient bus bars and smaller connectors for electric vehicle traction inverters, as well as for applications such as wireless and wired charging systems.To produce a lighter weight conductive material with improved performance, ORNL researchers deposited and aligned carbon nanotubes on flat copper substrates, resulting in a metal-matrix composite material with better current handling capacity and mechanical properties than copper alone. Incorporating carbon nanotubes, or CNTs, into a copper matrix to improve conductivity and mechanical performance is not a new idea. CNTs are an excellent choice due to their lighter weight, extraordinary strength and conductive properties. But past attempts at composites by other researchers have resulted in very short material lengths, only micrometers or millimeters, along with limited scalability, or in longer lengths that performed poorly. The ORNL team decided to experiment with depositing single-wall CNTs using electrospinning, a commercially viable method that creates fibers as a jet of liquid speeds through an electric field. The technique provides control over the structure and orientation of deposited materials, explained Kai Li, a postdoctoral researcher in ORNL's Chemical Sciences Division. In this case, the process allowed scientists to successfully orient the CNTs in one general direction to facilitate enhanced flow of electricity. The team then used magnetron sputtering, a vacuum coating technique, to add thin layers of copper film on top of the CNT-coated copper tapes. The coated samples were then annealed in a vacuum furnace to produce a highly conductive Cu-CNT network by forming a dense, uniform copper layer and to allow diffusion of copper into the CNT matrix. Using this method, ORNL scientists created a copper-carbon nanotube composite 10 centimeters long and 4 centimeters wide, with exceptional properties. The microstructural properties of the material were analyzed using instruments at the Center for Nanophase Materials Sciences at ORNL, a U.S. Department of Energy Office of Science user facility. Researchers found the composite reached 14% greater current capacity, with up to 20% improved mechanical properties compared with pure copper. Tolga Aytug, lead investigator for the project, said that "by embedding all the great properties of carbon nanotubes into a copper matrix, we are aiming for better mechanical strength, lighter weight and higher current capacity. Then you get a better conductor with less power loss, which in turn increases the efficiency and performance of the device. Improved performance, for instance, means we can reduce volume and increase the power density in advanced motor systems." The work builds on a rich history of superconductivity research at ORNL, which has produced superior materials to conduct electricity with low resistance. The lab's superconductive wire technology was licensed to several industry suppliers, enabling such uses as high-capacity electric transmission with minimal power losses. While the new composite breakthrough has direct implications for electric motors, it also could improve electrification in applications where efficiency, mass and size are a key metric, Aytug said. The improved performance characteristics, accomplished with commercially viable techniques, means new possibilities for designing advanced conductors for a broad range of electrical systems and industrial applications, he said. The ORNL team also is exploring the use of double-wall CNTs and other deposition techniques such as ultrasonic spray coating coupled with a roll-to-roll system to produce samples of some 1 meter in length.

Source https://www.sciencedaily.com/releases/2020/09/200921130631.htm

9. NRC Approves First U.S. Small Modular Reactor Design

The U.S. Nuclear Regulatory Commission (NRC) recently issued its final safety evaluation report on NuScale Power's small modular reactor (SMR) design. This accomplishment is the first of its kind for a SMR and puts NuScale on track to receive a full design certification from the regulator by August 2021. The milestone is the direct result of more than $400 million in funding by the U.S. Department of Energy (DOE) since 2014 to accelerate the development and deployment of SMRs. The NRC accepted NuScale's SMR design certification application in March 2017. The 12,000-page application took less than 42 months to review and included more than 2 million pages of additional documents for regulatory audits. The final safety evaluation report issued by the NRC is the first of its kind for a SMR and represents the technical review and NRC staff's approval of the NuScale SMR design. The NuScale Power Module is an advanced light-water small modular reactor capable of generating 60 megawatts of electricity. Each power plant can house up to 12 modules, which will be factory-built and about a third of the size of a large-scale reactor. Its unique design allows the reactor to passively cool itself without any need for additional water, power or even operator action. This key safety feature could lead to a reduction in the emergency planning zone to the site boundary—significantly reducing the footprint of the power plant. Upon receiving full certification, utilities will be able to reference the design when applying for a combined license to build and operate the new reactors in the United States. DOE is supporting the siting of the nation's first 12-module power plant at Idaho National Laboratory. Operation is expected to begin in 2029. "This is what successful private-public partnerships looks like," said Dr. Rita Baranwal, the Assistant Secretary for Nuclear Energy. "DOE is proud to support the licensing and development of NuScale's Power Module and other SMR technologies that have the potential to bring clean and reliable power to areas never thought possible by nuclear reactors in the U.S., and soon the world." DOE's support for the NuScale Power module can be traced back to the inception of its design at Oregon State University back in 2000. Since then, DOE has provided more than $400 million to support the design, licensing and siting of the NuScale Power Module as well as initial design efforts for other domestic SMR designs. Through the Carbon Free Power Project, DOE is working with Utah Associated Municipal Power Systems (UAMPS) and its members to showcase this first-of-a-kind technology. The NRC is preparing a rulemaking to certify the NuScale SMR design. Once certified, the SMR will join six other light water reactor designs cleared by the NRC. The regulator is also reviewing the nation's first boiling water SMR design developed by GE-Hitachi. Upon reaching a decision to move forward with the Carbon Free Power Project, UAMPS and its members will continue characterizing its preferred site and will initiate the development of a Combined License Application for review by the NRC. In addition to the Carbon Free Power Project, NuScale has signed agreements with entities in Canada, Romania, the Czech Republic, and Jordan to build future plants.

Source https://www.energy.gov/ne/articles/nrc-approves-first-us-small-modular-reactor-design#:~:text=The%20U.S.%20Nuclear%20Regulatory%20Commission,the%20regulator%20by%20August%202021

10. A Multishot Lensless Camera in Development Could Aid Disease Diagnosis

A new type of imaging that does not require a lens and uses reconfigurable particle-based masks to take multiple shots of an object is being developed by researchers at Penn State. The electric-field directed self-assembling mask technology is expected to have uses in lower-cost and faster disease diagnosis, the enhancement of optical microscopy, and may even lead to thinner cellphone technology. The researchers create a mask of microscopic gold wires and place it near the object that will be imaged. The mask scatters the light reflected off the object and an image sensor collects the light. An electric current rearranges the particles in the mask, producing a new mask with every iteration, and the system records each new image. The multiple light captures are then computationally reconstructed into the original object image, resulting in highly improved resolution and quality. "We are not the only group to do lens-free imaging," explained Jennifer Miller, a researcher. "What is different about our work is that typically you would need to make multiple masks and physically move them around to get multiple images. This becomes bulky and expensive and negates some of the simplicity that is the advantage of lens-free imaging." In typical microscopy, there exists a trade-off between the field of view and the power of the resolution, so a 10x field is wider than a100x field. By using a lens-free imaging technology, it is possible to combine a wide field of view with high magnification for lower-cost images and faster diagnosis of disease. This could be especially useful in developing countries where high-end microscopes are not available. "Traditional masks are passive," said Cheng-Yu Wang, doctoral candidate in electrical engineering. "We can add functionalization to our microwire, like polarization, selectivity and plasmonic effects, that make our imaging system more powerful." In the case of cellphones, one major contributor to their bulk is due to the camera lens needing to be a certain distance to the detector. A lens-free camera could help minimize the space requirement. Likewise, a lens-free system added to a cellphone could turn the cellphone into a low-power microscope.

Source https://www.sciencedaily.com/releases/2020/09/200923124553.htm

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Engineering Innovation in India

Midhani Supplies Nickel Wire Used in 30,000 Ventilators

A critical component in ICU ventilators is indigenously manufactured and supplied by city-based defence PSU, Midhani, at Kanchanbagh. The 160-micron pure nickel wire used in oxygen sensors for manufacture of 30,000 ventilators was supplied by Midhani. Bengaluru-based defence PSU, Bharat Electronics Limited (BEL), in collaboration with Skanray Technologies Ltd, Mysuru, produced the ventilators on a war-footing in the wake of the Covid-19 situation. “We have delivered more than the requirement. If necessary, we can provide more at a short notice,” Midhani chairman and managing director Sanjay Kumar Jha told TOI. The Union health ministry took a decision that ICU ventilators should be manufactured indigenously and approached the DRDO with the proposal.

Until the pandemic, ventilators were imported but considering the fact that all countries were affected due to Covid-19 there was a big possibility that the requirement of India may not be met by the international market. That is why the plans for indigenous production was made. While BEL was given the task of manufacturing the equipment, Midhani was asked if it could come up with the pure nickel wire with the specifications. “Within 45 hours, we were able to complete the task given to us. This was done on a war-footing. We had never previously made the nickel wire as per the specification that was required. But, we delivered,” Sanjay Kumar said. Midhani has expertise of wired drawing at the level of 1mm or 1.2mm but for the requirement sought, it was a challenge and that was to provide 1/10th of the thickness it had made for an earlier use. “We then fixed the parameters and optimised it. That is the skill Midhani has where requirements can be delivered even in short notice. Defence requirements are unique and urgent,” Sanjay Kumar said.

Source https://timesofindia.indiatimes.com/city/hyderabad/midhani-supplies-nickel-wire-used-in-30000-ventilators/articleshow/78341575.cms

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