

E-Newsletter - Indian National Academy of Engineering (INAE)

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# E-Newsletter


## INAE e-Newsletter Vol. XI, Issue 5, May 7, 2020




INAE Vision  
2020-2025




Academy  
Activities




Articles by INAE  
Fellows



Engineering and  
Technology  
Updates



Engineering  
Innovation in  
India



Previous  
E-newsletter

The Indian National Academy of Engineering comprises India's most eminent Engineers, Engineer-Scientists and Technologists.

**Founded:** 20 April 1987  
**President:** Dr. Sanak Mishra  
**Email:** president.inae@inae.in

**Deputy Executive Director:**  
Lt Col Shobhit Rai (Retd)

**Address:**  
6th Floor, Unit No 604-609, Spaze I-

10:15 06-07-2020

## ACADEMY ACTIVITIES

### INAE Announcements

**Nominations have been invited for the following:**

- **Abdul Kalam Technology Innovation National Fellowship:** Last Date for receipt of Nominations for the year 2020-2021 – **June 30, 2020**
- **INAE Young Entrepreneur Award:** Last Date for receipt of Nominations- **June 30, 2020**
- **INAE Woman Engineer of the Year Award:** Last Date for receipt of Nominations - **June 15, 2020**
- **Innovative Student Projects Award 2020:** Last Date for receipt of Nominations- **August 31, 2020**

### **Commemoration of INAE Foundation Day**

Indian National Academy of Engineering (INAE) was founded on April 20, 1987 – the date on which the Academy was registered under the Societies Registration Act 1860 and subsequently the Inaugural Function of the Academy was held on April 11, 1988, wherein the erstwhile Prime Minister Mr. Rajiv Gandhi was the Chief Guest. Last year however, the Foundation Day celebrations were organized on April 11 by the INAE Local Chapters as well as INAE Headquarters by conduct of activities and meetings. From this year onwards, it was decided to commemorate the Foundation Day of the Academy by organizing the celebrations on April 20, each year, which is the correct date of the INAE Foundation Day. On this occasion, Dr Sanak Mishra, President, INAE forwarded a message on April 20, 2020 to INAE Fellows and Young Associates to commemorate the INAE Foundation Day, in lieu of the activities planned by INAE Local Chapters across the country and INAE Headquarters, which had to be cancelled subsequently, due to the Lockdown imposed by the Government to mitigate the outbreak of the COVID-19 Pandemic. A copy of the Message from Dr Sanak Mishra, President, INAE to the Fellows and Young Associates can be viewed by clicking here .....

### **Commitment of INAE to the Efforts of Government of India towards Containment and Eradication of COVID-19 Pandemic**

Dr Sanak Mishra, President INAE wrote a letter to Dr Pramod Kumar Mishra, Principal Secretary to the Prime Minister conveying utmost admiration in the exemplary manner in which measures have been taken by the Government of India under the inspired leadership of the Hon'ble Prime Minister, towards the containment and eradication of the COVID-19 pandemic. He lauded the Government initiatives encompassing provision of medical services and facilities; promotion of indigenous medical testing facilities; development of cost-effective medical equipment; excellent governance; economic relief measures; repatriating Indian citizens from affected countries; appropriate education of citizens; timely lock-down of the country and ensuring essential supplies and facilities across the country. Dr Sanak Mishra highlighted that INAE commits itself to extend all and any support required by the Government for the furtherance of its initiatives and measures for the containment and eradication of the COVID-19 pandemic and he looked forward to the Academy contributing to the ongoing and novel measures and innovative strategies of the Government of India.

A copy of the letter from **Dr Sanak Mishra, President INAE addressed to Dr Pramod Kumar Mishra, Principal Secretary to the Prime Minister** can be viewed by clicking here ...

In this regard, Dr Sanak Mishra, President INAE had written a letter to the INAE Fellowship and INAE Young Associates requesting for relevant expertise in the engineering fields from Fellows who can come forward to offer their expertise to mitigate any dimension of the COVID 19 Pandemic from engineering perspective.

A copy of the letter from **Dr Sanak Mishra, President INAE addressed to the INAE Fellowship and INAE Young Associates** can be viewed by clicking here ...

Subsequently, the names of INAE Fellows and Young Associates willing to contribute to contribute to the pertinent activities and measures initiated by DST in the containment and eradication of the COVID was forwarded by Dr Sanak Mishra, President INAE to Prof Ashutosh Sharma, Secretary, DST.

#### **Letters from Dr Sanak Mishra, President, INAE to NITI Aayog, PSA to GoI and DST**

Dr Sanak Mishra, President, INAE wrote letters to Dr. VK Saraswat, Member, NITI Aayog; Prof K VijayRaghavan, Principal Scientific Adviser to Govt. of India and Prof. Ashutosh Sharma, Secretary, Department of Science & Technology (DST) apprising them about the recent initiatives taken by INAE towards meeting the National needs and strategic priorities.

Copies of the above mentioned letters dated April 7, 2020 from Dr Sanak Mishra, President INAE addressed to Dr. VK Saraswat, Member, NITI Aayog; Prof K VijayRaghavan, Principal Scientific Adviser to Govt. of India and Prof. Ashutosh Sharma, Secretary, Department of Science & Technology along with the note on the recent initiatives of INAE can be viewed by clicking here.....

#### **Preparation of Revised Memorandum of Association, etc for INAE, as Advised by DST**

During the Special General Meeting of Fellows held on December 14, 2019 at Jaipur, Dr Sanak Mishra, President, INAE had apprised the House that INAE had received a letter from DST, dated August 28, 2019 to the effect that INAE has been advised to recast its Memorandum of Association (MoA), as per a model MoA recommended by DST in order to make the affairs of INAE regular and in conformity with the provisions of Government/CAG with respect to rules/regulations/ guidelines which are applicable to Autonomous Bodies, which have been receiving grants from DST. In addition, the DST letter also asked for Bye-Laws, and Rules & Regulations. Copies of the proposed DST Model for MoA, DST Model for Bye-Laws, Existing MoA of INAE and Existing Ordinances of INAE, were tabled during the meeting, for information of the House. It was also brought that at present, INAE has an MoA. In addition, INAE has a set of "Ordinances" to regulate its functioning, however, it does not have Bye-Laws. The House had approved the re-casting of the MoA and Rules & Regulations and also drafting of the Bye-Laws of the Academy, as per model templates of DST, and also recommended that the necessary actions to undertake this task, be done on priority. In addition, keeping in view the urgency of the matter, the House had authorized President, INAE to take all necessary actions in this regard.

The task of recasting of the MoA and the drafting of the Bye-Laws, adhering to model templates provided by DST, while at the same time maintaining the essence of INAE Rules & Regulations, was undertaken by the Academy. The draft recast MoA and Bye-Laws along with relevant enclosures were approved by the Governing Council Members over email in March 2020 in lieu of the Governing Council Meeting scheduled on March 6, 2020 which was called off due to the outbreak of the COVID-19 Pandemic. The Governing Council Members while granting approval recommended forwarding of the recast MoA and bye-laws along with all relevant enclosures to DST. The draft recast MoA and bye-laws along with all relevant enclosures have since been forwarded to Department of Science and Technology for due consideration.

### **INAE Woman Engineer of the Year Award 2020**

Indian National Academy of Engineering (INAE) has instituted a new award named “INAE Woman Engineer of the Year Award” from this year i.e. 2020 onwards, in order to recognize and promote meritorious contributions of women in engineering profession as part of the initiative on women empowerment. Nominations have been invited for the INAE Woman Engineer of the Year Award 2020 during the month of March 2020. The purpose of the award is to recognize and honour deserving women engineers, every year, who have made outstanding contributions to any field of engineering and technology in India and may serve as role models to budding women engineering professionals in the future. The award aims to recognize meritorious and original contributions made by woman engineers in India from academia, research organizations or industry, whose individual efforts have made a significant difference in any branch of engineering and technology, by way of breakthrough innovation and disruptive change in different fields of engineering and have helped to advance the knowledge and competence to the benefit of the profession and people in India. The subject award is to be bestowed on an individual only and the nominations for the award should be nominated and seconded only by the Fellows of INAE. Woman engineers between the age of 40 to 60 years, who should be a citizen of India and working in India are eligible for nomination. In case the nominee is an INAE Fellow, she should not be a member of the INAE Governing Council during the year of the award.

INAE will honour three women engineers between the age of 40 to 60 years, every year with this award – one from each of the three categories, (i) Academia, (ii) Industry and (iii) R&D. The award carries a cash award of Rs. 2 lakhs and a citation. The last date for the receipt of nominations for the subject award is now extended to June 15, 2020. The guidelines and nomination format for nomination can be downloaded from INAE website [www.inae.in](http://www.inae.in)

### **INAE Young Entrepreneur Award 2020**

Nominations for INAE Young Entrepreneur Award 2020 are now open and launched at INAE website. A letter from Prof. Indranil Manna, Vice-President, INAE seeking nominations for INAE Young Entrepreneur Award 2020 has been sent to INAE Fellowship. In addition, nominations have been also invited from 372 Incubation Centres and Start-ups all over India supported by various Government agencies viz. Incubators supported by Department of Science and Technology (DST), Incubators under National Science and Technology Entrepreneurship Development Board (NSTEDB) supported by DST, Science & Technology Entrepreneurship Park (STEP) supported by DST, Incubators supported by Department of Biotechnology (DBT), Incubators supported by Department of Electronics & Information Technology (DeitY), Incubators under Micro, Small and Medium Enterprises (MSME) and Incubators supported by Ministry of Human Resource Development (MHRD), besides 29 IIT Research Parks. Apart from seeking nominations, an advertisement has also been published in CII Communique issue for May 2020. The last date of receipt of nominations is **June 30, 2020.**

### **INAE Innovative Student Projects Award 2020**

The nominations for Innovative Student Projects Award are sought at three levels viz., B.E./B.Tech, M.E./M.Tech and Ph.D as per the eligibility criteria listed below:

- Final Year (4th year) B.E./B.Tech projects completed upto June 30, 2020 for the academic year 2019-2020.
- M.E./M.Tech theses examined from July 1, 2019 upto June 30, 2020 during the academic year 2019-2020.
- Ph.D. theses examined and accepted/recommended for Award from June 1, 2019 upto May 31, 2020.

The last date of the receipt of Nominations is July 7 each year. The reason for keeping the last date as July 7 each year is because the academic sessions are completed by June 30 each year in most of the Academic institutions in the Country. The date of first shortlisting of nominees is generally kept in

second week of July each year (this year 17<sup>th</sup> July) wherein the nominees are shortlisted for making the presentation of their work before the Selection Committee.

The Apex Committee during its meeting on May 29, 2020, discussed that in view of the ongoing COVID -19 Pandemic, this year the dates of defence of B.Tech Projects and M.Tech. Theses have been postponed. It was informed that the defence of Bachelor level projects and Master's Theses are likely to be over by July 31, 2020.

In view of above, the following was decided.

- (a) The eligibility criteria for Innovative Student Projects Award 2020 at B.E./B.Tech and M.E./M.Tech levels be amended as given below.
  - Final Year (4th year) B.E./B.Tech projects completed upto July 31, 2020 for the academic year 2019-2020.
  - M.E./M.Tech theses examined from July 1, 2019 upto July 31, 2020 during the academic year 2019-2020.
- (b) The last date of the receipt of Nominations for Innovative Student Projects Award 2020 be kept as August 31, 2020.
- (c) After the Selection Committee selects the nominees by presentation over Webex, approval for the selected candidates will be taken from the Governing Council members by circulation.

#### **Launch of INAE Webinar Series**

INAE has launched a Webinar Series on topics encompassing all sectors and disciplines of engineering and technology. It has been a long-cherished plan of the Academy to launch the Webinar Series in the year 2020. The INAE Webinar Series is an important new initiative of the INAE Digital Platform. INAE is geared to host events on this platform for the benefit of the Fellowship. It is planned to hold at least one Webinar every month, and if felt necessary, one every fortnight. 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. A total of 58 INAE Fellows/ Foreign Fellows/Young Associates/other invitees participated in the first Webinar held on May 23, 2020, out of 103 registered participants. A video is being prepared of the webinar which will be uploaded shortly on INAE website for the benefit of those fellows who could not attend the same. In addition, feedback and suggestions from the Fellows are being obtained which will be collated suitably.

A second Webinar is scheduled to be held in second week of June 2020 wherein a new Webinar platform is proposed to be used. The second webinar of the series is on the topic "Does Hydrogen have a role in India's Energy Strategy?" and the four speakers are Dr. P C Maithani, Director, MNRE, Govt. of India; Dr. SSV Ramkumar, Director R&D, IOCL; Dr. Ashish Lele, Senior VP and Head, Advanced Materials and Alternate Energy, Reliance Industries Limited and Dr. RR Sonde, EVP, Research, Technology and Innovation, Thermax. Mr MV Kotwal, Ex - Member of L&T Board & President, Heavy Engineering is the Moderator of the second webinar. A Q&A session is planned after the four speakers have made their presentations.

**Invitees:** Fellows/Foreign Fellows and Young Associates

#### **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 – 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 first Volume of Transactions of the Indian National Academy of Engineering is Volume 5, Issue 1, March 2020, ISSN: 2662-5415 (Print) 2662-5423 (Online)**

**In this issue there are (10 articles) as given below.**

**Review Article**

Microstructure–Texture–Mechanical Property Relationship in Alloys Produced by Additive Manufacturing Following Selective Laser Melting (SLM) Technique  
Satyam Suwas, Deepak Kumar Pages 1-10

**Original Article**

Liquid Metal Corrosion Studies for Fusion Reactor Applications: Facility Development and Basic Research  
P. Chakraborty, V. Kain, R. Tewari Pages 11-16

**Original Article**

Process Analysis of Chemical Looping Systems for Dimethyl Ether Synthesis from Coal  
Fanhe Kong, Qiaochu Zhang, Yan Liu, Jordan Swift, Darryl Tene Youmbi, Andrew Tong & Liang-Shih Fan Pages 17-26

**Original Article**

Electrical Properties of Pure NiO and NiO:Ag Thin Films Prepared by Pulsed Laser Deposition  
Omar Abdulsada Ali, Mohammed A. Hameed & Qahtan Ghatih Al-Zaidi Pages 27-31

**Original Article**

Graphene Flake-Based Electrodes for High-Energy and Power Lithium-Ion Semi-flexible Rechargeable Batteries  
Sanjay Kanojia, Mohd. Imamuddin, Subhash Mandal, Debmalya Roy, Kingsuk Mukhopadhyay & N. Eswara Prasad Pages 33-38

**Original Article**

Modification of On-Site Velocity Boundary Condition in LBM for D3Q27D3Q27 Lattice Structure  
Alankar Agarwal Pages 39-49

**Original Article**

Eutrophication Risk Assessment by Estimation of Denitrification Rate in Yamuna River Sediments  
Shikha Sharma, Shakeel Ahmad Khan, Amit Kumar, Pawan Kumar Jha & Tanu Jindal Pages 51-60

**Original Article**

Multi-phase MPSP Guidance for Lunar Soft Landing  
Avijit Banerjee, Radhakant Padhi Pages 61-74

### **Original Article**

Large-Scale Manufacture of Nickel Alloy Turbine Rotor Forgings for A-USC Power Plants  
B. Donth, N. Blaes, A. Diwo, D. Böttcher Pages 75-82

### **Original Article**

Development of Test Protocol for Accelerated Creep and Transient Thermo-mechanical Testing of A-USC Steam Turbine Rotor in High-Temperature Spin Test Rig  
Bishnu Pada Pal, M. Naga Suresh, K. Ramakrishna, A. Narayana Teja, Supak Pore, Prabhat Kr. Hensh, Somnath Nandi & Maneesh Batrani Pages 83-88

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.

### **German Chancellor Fellowships by Humboldt Foundation for Tomorrow's leaders**

An email has been received from DST forwarding a communication from Mr S. K. Varshney, Adviser & Head, International Bilateral Cooperation, Department of Science & Technology (DST), Government of India informing about nominations for German Chancellor Fellowships for Tomorrow's leaders, a yearly program handled by the Humboldt Foundation. The Alexander von Humboldt Foundation grants up to 50 German Chancellor Fellowships every year to prospective leaders from Brazil, China, India, Russia and the USA – irrespective of their field of work. Recipients use the Fellowship to conduct together with their German host and mentor a socially-relevant project that they have developed themselves. The Chancellor of the Federal Republic of Germany is the patron of this fellowship programme.

#### **The candidate applying for this Fellowship should be:**

- The applicant must be a national of Brazil, China, India, Russia or the United States.
- Bachelor's or equivalent academic degree completed less than twelve years before the beginning of the fellowship.
- A confirmation of supervision by the host in Germany.
- A project plan which candidates must draw up on their own and coordinate with their host.
- Initial proven leadership experience

#### **Fellowship benefits for recipients:**

- A monthly fellowship of €2,170, €2,470 or €2,770, depending on your qualifications.
- Individual mentoring during your stay in Germany.
- Additional financial support for items such as family members accompanying you, travel expenses or a German language course.
- A study tour of Germany, an opportunity to meet the German chancellor at the end of your stay and a number of events during which you can make contact with other fellows and representatives of German companies and institutions.
- Extensive alumni sponsorship, particularly to help you sustain contact with collaborative partners in Germany during your entire professional career.

**Application deadline:** 15 September 2020.

**Period of sponsorship:** 1 October 2021 – 30 September 2022

Fellows desirous of recommending candidates from their organization may download all relevant information by accessing the links given below.

**Further information, a list of all application requirements and a link to the online application form** are available at [www.humboldt-foundation.de/youngleaders](http://www.humboldt-foundation.de/youngleaders)

**Advice and contact:** If you have any questions regarding the German Chancellor Fellowship Programme or would like individual guidance, please contact at [info@avh.de](mailto:info@avh.de)<mailto:info@avh.de>.

You can find **examples of projects conducted** at <https://www.humboldt-foundation.de/web/buka-testimonials-en.html>

**Abdul Kalam Technology Innovation National Fellowship – Call for Nominations**

Indian National Academy of Engineering (INAE) and Science and Engineering Research Board (SERB), Department of Science and Technology (DST) launched the INAE-SERB, DST Abdul Kalam Technology Innovation National Fellowship in the year 2017, to recognize, encourage and support translational research by Indian Nationals/ Overseas Citizens of India (OCIs) working in various capacities of engineering profession, in public funded institutions in the country. The nominees for the subject Fellowship should have a minimum of 5 years’ service left in the parent organization. The Fellowship amount is Rs 25,000/- per month in addition to salary being drawn and a Research Grant of Rs.15.00 lakh per annum will also be provided. An Overhead of Rs.1.00 lakh per annum will also be provided to the host institute. A Maximum of 10 Fellowships will be awarded per year. The duration of the Fellowship will be initially for three years, extendable by upto two more years depending on the performance and the Fellowship can be held for a maximum of 5 years.

The scheme has received a good response and has gained visibility in the engineering community across the country. A maximum of 10 Fellowships are awarded in a year and six Fellowships were conferred in the Financial Year 2017-18, eight in the Financial Year 2018-19 and seven during the Financial Year 2019-20. A total of twenty-one nominees have been selected for conferment of the subject Fellowship since its inception. The next call for nominations for consideration during the Financial Year 2020 -2021 has been announced. The last date for the receipt of nominations is **June 30, 2020**. An advertisement to this effect has also been published in Hindustan Times, All India Edition on May 31, 2020 (Sunday)

**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.

<p>Dr. Raja Manuri Venkata Gopala Krishna Rao, FNAE, Scientist 'G', Founder/Head-FRP Dvn-NAL-CSIR(Rtd)</p>	<p>East Point College of Engineering &amp; Technology, Bengaluru</p>	<p>Delivered lectures on "Introduction to Polymer Matrix Composites", "Structure-Property Relationships in Polymer Matrix Composites (PMCD)", "Processing &amp; Manufacturing of PMC Products (Processing &amp; Fabrication Technologies"</p>
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	March 2, 2020 March 4, 2020 March 6, 2020	According to the feedback received from the College, Dr. Rao's lectures and interactions with the participating students/ faculty - very lucidly brought out the nuances of the composite material processing and fabrication technologies, as appropriate to the end product geometries. He expressed that the interactions were very useful for our students to prepare them for their entries with the industry.
Dr. Sreekumar Thaliyil Veedu  Senior Consultant, Reliance Industries Ltd. (RIL)	DKTE Society's Textile & Engineering Institute, Ichalkaranji  March 11-13, 2020	Delivered lectures on "Acrylic Fibre Manufacturing and its Applications", "Fibres for Fashion and its Application", "High Performance Fibres", "Conducting Literature Review and Organisation Research"  According to the feedback received from the College, students and faculty members of textile Department were benefited by the lectures of DVP. Aspirant Ph.D. Candidates received the direction of research and helped to finalize their Ph.D. topics.

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

To view a list of International/ National Conferences/Seminars being held in the month of June 2020, click here....

### **Honours and Awards**

1.	Prof. Sankar K. Pal, FNAE, Distinguished Scientist and Former Director, Indian Statistical Institute (ISI), Calcutta, currently holding the position of INSA Distinguished Professorial Chair, has been selected as a National Science Chair (NSC), Government of India. The selection of this prestigious award is announced by the Science and Engineering Research Board (SERB), Department of Science and Technology (DST), Govt. of India. He would like to assume the office of this new position from August 1, 2020.
2.	Prof. (Dr.) T.C. Rao, FNAE, Formerly, Director, Regional Research Laboratory (CSIR), Bhopal, formerly Head, Dept. of Fuel and Mineral Engineering, ISM Dhanbad has been chosen to head a Committee constituted by Ministry of Mines to prepare a holistic Vision Plan for the mineral sector including characterization, beneficiation, end-use and recycling, keeping in mind the economic viability and economic importance of minerals for the country.

### **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>

## International/National Conferences in June 2020

International Conference & Exposition on Mechanical, Material and Manufacturing Technology (ICE3MT2020) on 12th to 13th June 2020 at Hyderabad

<https://conferencealerts.com/show-event?id=224912>

International Conference on Intelligent Manufacturing and Energy Sustainability on 19th to 20th June 2020 at Hyderabad

<https://conferencealerts.com/show-event?id=225655>

2nd International Conference on Emerging Trends in Information Technology (ICETIT-2020) on 19th to 20th June 2020 at New Delhi

<https://conferencealerts.com/show-event?id=220229>

International Conference on Emerging Technologies in Electrical Engineering on 19th to 20th June 2020 at Hyderabad

<https://conferencealerts.com/show-event?id=226220>

3rd International Conference on Soft Computing and Signal Processing (ICSCSP-2020) on 19th to 20th June 2020 at Hyderabad

<https://conferencealerts.com/show-event?id=226379>

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



# भारतीय राष्ट्रीय अभियांत्रिकी अकादमी Indian National Academy of Engineering

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**डॉ. सनक मिश्रा/Dr. Sanak Mishra**

FNAE, FNASc., FIIM, FIOD, FCSI, FIE, FAIMA,

BE & Distinguished Alumnus Award, Indian Institute of Science, Bangalore

MS & PhD and Distinguished Alumnus Award, University of Illinois at Urbana-Champaign (USA)

Alexander von Humboldt Fellow (Germany)

**अध्यक्ष/President**

Formerly: Managing Director, Rourkela Steel Plant;

Director, Steel Authority of India Ltd. (SAIL);

Vice President of ArcelorMittal, CEO India Projects;

Secretary General, Indian Steel Association

President, Indian Institute of Metals

AICTE - INAE Distinguished Visiting Professor

Mob.: +91-9810956664, E-mail: mishra.sanak@gmail.com

Ref: INAE/205/FD

April 20, 2020

## Message from President, INAE Regarding Foundation Day of INAE

Dear Colleague,

At the outset, I express my sincere wishes for your good health and safety in these challenging times of the worldwide COVID -19 Pandemic. You may kindly recall that INAE was founded on April 20, 1987 – the date on which the Academy was registered under the Societies Registration Act 1860 and subsequently the Inaugural Function of the Academy was held on April 11, 1988, wherein the erstwhile Prime Minister Mr. Rajiv Gandhi was the Chief Guest. Last year however, the Foundation Day celebrations were organized on April 11 by the INAE Local Chapters as well as INAE Headquarters by conduct of meaningful activities and meetings. From this year onwards, in consultation with former Presidents of INAE, it has been decided to commemorate the Foundation Day of the Academy by organizing the celebrations on April 20, each year, which is the correct date of the INAE Foundation Day. It would indeed have been delightful had it been feasible to organize the INAE Foundation Day celebrations so meticulously planned by several INAE Local Chapters this year, however, in view of the current emergency health situation and national lockdown declared by the Government of India for the containment of the COVID -19 Pandemic, these functions subsequently, perforce had to be cancelled.

In view of above, I felt it pertinent to forward this message and reach out to the INAE Fellows and Young Associates who have over the years have contributed to the growth of the Academy and also helped enhance INAE's visibility in the national and international engineering fora and policy domain. My sincere thanks are expressed to all former Presidents and office bearers of INAE since its inception and the esteemed Fellowship and enthusiastic Young Associates who have all shown utmost sincerity and dedication in devoting their precious time towards contributing to the activities and programmes of INAE, that have added value to its image and maturity as a recognized body of eminent engineers.

As you may be aware, I have confirmed the commitment of INAE to the efforts of Government of India in the fight against the COVID-19 Pandemic vide my letter addressed to Dr Pramod Kumar Mishra, Principal Secretary to the Prime Minister wherein I have conveyed utmost admiration in the exemplary manner in which measures have been taken by the Government of India under the inspired leadership of the Hon'ble Prime Minister, towards the containment and eradication of the COVID-19 pandemic. In the letter, I lauded the Government initiatives encompassing provision of medical services and facilities; promotion of indigenous medical testing facilities; development of cost-effective medical equipment; excellent governance; economic relief measures; repatriating Indian citizens from affected

countries; appropriate education of citizens; timely lock-down of the country and ensuring essential supplies and facilities across the country. It was also highlighted that INAE commits itself to extend all and any support required by the Government for the furtherance of its initiatives and measures for the containment and eradication of the COVID-19 pandemic. Subsequently, the INAE Fellowship and INAE Young Associates were requested for relevant expertise in the concerned engineering fields to offer their expertise to mitigate any dimension of the COVID 19 Pandemic from engineering perspective. The inputs received were communicated vide my letter to Prof Ashutosh Sharma, Secretary, DST with the objective of making meaningful contributions to the various measures and initiatives of the Government by providing the pertinent technical inputs to synergize the efforts, with innovative engineering interventions and providing consultancy in concerned fields which has been appreciated.

You all have witnessed that since the raising of the Academy, INAE has undergone a change in terms of the increase in its visibility in the national engineering domain. In the recent past, INAE is recognized as an advisory body to the Government Departments/Agencies for providing inputs for engineering interventions to help solve problems on topics of current engineering interest and in framing of national policies on identified areas. To facilitate the interface with the Government, INAE has in place joint Consultative Committees with Department of Science and Technology (DST) and Office of Principal Scientific Advisor (PSA) to the Government of India, which meet periodically to deliberate and identify topics of interest to the Government, to align future activities of the Academy accordingly.

INAE has embarked on a journey of progress over the decades with the institution of novel events and activities encompassing all aspects and fields of engineering and technology and also promoting of engineering education which is vital for the growth of the engineering profession. It is my privilege to recapitulate some landmark flagship events and activities that have gained national recognition. INAE launched an annual mega event of engineers as “Engineers Conclave” in 2013 which is organized jointly with major engineering organizations on rotation basis, with the objective of providing a platform for engineers from allied fields to meet, deliberate and recommend right engineering solutions to some of the pertinent issues of national importance. The seventh Engineers Conclave 2019 was organized jointly with Bharat Electronics Limited (BEL) in September 2019 at BEL Academy of Excellence (Nalanda), Bangalore and the two themes were “Defence Technology & Innovation” and “Transformation of Rural India Using Digital Technologies”. The Inaugural Session of the Engineers Conclave 2019 was graced by the Chief Guest, Hon’ble Raksha Mantri Shri Rajnath Singh who delivered a thought provoking address. Actionable recommendations based on the deliberations in terms of engineering interventions are being actively progressed with the concerned Government Departments/Agencies.

During a meeting of DST – INAE Consultative Committee held in November 2019 it was suggested that INAE should participate in the 107<sup>th</sup> Indian Science Congress Expo from January 3-7, 2020 being held at University of Agricultural Sciences, Bangalore, to increase the outreach of the Academy, within the scientific and engineering fraternity. Accordingly, INAE set up a stall on the activities of the Academy, which was well received by the visitors. As tasked by DST, a project entitled, “Pilot Project on Safe Laboratory Practices and Laboratory Waste Disposal” was undertaken with the objective of creating an implementable plan of action to enhance the awareness of health and safety issues in chemical laboratories as well as establish best practices for the disposal of chemical and hazardous wastes in the laboratories of universities, colleges and research institutions in India. The report has since been prepared and forwarded to DST. At the behest of DST, INAE had also conducted two Round Table meetings on “Clean Coal Technologies in India: Current Status, Demands and Aspirations – Pathways to Achievements” in 2016 at New Delhi. The objective of the round tables was to examine the various aspects of clean coal technologies and identify the technology gaps with respect to our national context and suggest thrust areas for future R&D efforts.

Another noteworthy event undertaken last year, at the behest of the Government Department/Agencies was the successful conduct of the one-day International Seminar on “Civil Aviation – Regional Air Connectivity” organized jointly by INAE with the Ministry of Defence Production and the Ministry of Civil Aviation as part of the Aero India Show on 21<sup>st</sup> February 2019 at Bangalore. The seminar was well attended with representation from Government and globally recognized engineering luminaries in the Aerospace Sector. It is a matter of pride for the Academy that our initiative to provide inputs for the development of indigenous Regional Transport Aircraft (RTA) has since been approved by the PMO and the proposal for constituting a Special Purpose Vehicle (SPV) as recommended by INAE, is being progressed with Ministry of Civil Aviation. In this regard, INAE Delegation met with Hon’ble Minister of Civil Aviation, Shri Hardeep Singh Puri on January 14, 2020 at New Delhi to present the recommendations on the “Development of Regional Transport Aircraft in the country”, which had emanated from the deliberations of various high-level meetings including the Engineers Conclave 2017, held at Bangalore. This is by far one of the most pathbreaking achievements of INAE that has been recognized at the national level.

I also would like to highlight some other notable events and initiatives that have seen active involvement of the engineering community. The National Frontiers of Engineering Symposium- a flagship event launched primarily to provide a platform for outstanding young engineers from industry, academic institutions and R&D organizations to come together and deliberate upon emerging and cutting-edge research leading to cross-disciplinary translational research and innovation, has gained significance and has since become a popular event for the upcoming engineers. The Thirteenth National Frontiers of Engineering Symposium was organized jointly with IIT Bhubaneswar in May – June 2019 at IIT Bhubaneswar and the themes were Augmented Reality and Virtual Reality; Smart Grid; Advances in Materials and Manufacturing Technology and Next Generation Transportation Systems.

INAE had launched a quarterly journal “INAE Letters” published by M/s Springer in the year 2016. The objective of the journal was 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 – International Journal of Engineering and Technology” and has become a full-fledged journal to include full Research Papers and Review Articles besides short communications. I request your inputs in popularizing the journal and soliciting submission of high quality research papers.

The Academy, realizing the importance of promoting young engineering students and Graduates and facilitating their engagement in the engineering activities at national level had instituted a Youth Forum in the year 2017, which was launched during the first Youth Conclave held at Birla Institute of Scientific Research, Jaipur in August 2017. The third INAE Youth Conclave was organized at IIT Delhi in August 2019. The engineering models and idea presentations were based on five topics of national importance namely (a) Health is Wealth (b) Digital Revolution (c) Environment Protection (d) Lab to Market and (e) Waste to Wealth.

The Abdul Kalam Technology Innovation National Fellowship launched by INAE jointly with Science and Engineering Research Board (SERB), DST in the year 2017, with the objective of encouraging and supporting translational research in engineering in public funded institutions in the country, has since gained momentum with the receipt of high quality nominations from Academic and R&D institutions across the country. Seven eminent nominees were conferred with the subject Fellowship during the last year.

INAE has recently instituted the award titled as “INAE Woman Engineer of the Year Award”. The purpose of the award is to recognize and honour our women engineers every year ,who have made outstanding contributions to engineering/technology in India and who will serve as role models.

Digitalization of the functioning of INAE is of high priority and an INAE Digital Platform has been instituted to facilitate the same. An INAE Digital Centre has also been created to house the Digital Platform which is located in the newly procured office space in the 9<sup>th</sup> Floor of the same building viz SPAZE, IT Park, Tower A, Gurgaon wherein the current INAE office is housed on the 6<sup>th</sup> floor. The INAE Digital Centre was inaugurated by Prof Ashutosh Sharma, FNAE, Secretary, DST on February 15, 2019.

A novel initiative of INAE at national level is the creation of the Frugal Innovation Nurturing programme, set up with the aim of nurturing prospective frugal grassroot technologies which have reached prototype stage and to commercialize them for the benefit of the citizens, as well as to promote the young innovators.

The eight INAE Local Chapters at Bangalore, Kolkata, Delhi, Pune, Mumbai, Kharagpur, Kanpur and Hyderabad have been energized and a number of interesting technical events have been conducted by them which have had good attendance and representation from experts in allied fields. Recently the Pune Local Chapter organized a Round Table Interaction of domain experts on "Role of Hydrogen in India's Energy Strategy" in February 2020 at Pune. The invited experts shared insights on the current and future global situation about use of Hydrogen as an energy source; discussed the overall situation in India with respect to technologies, capabilities and affordability for generation, storage, transportation and usage of hydrogen and concluded on the approach to be followed by INAE in forwarding recommendations to the Government.

In order to give a fillip to engineering education in the country, INAE is implementing three joint schemes with All India Council for Technical Education (AICTE) viz. AICTE-INAE Distinguished Visiting Professorship Scheme wherein Industry experts are encouraged to give series of lectures at an educational institution for a specific time period; AICTE- INAE Teachers Research Fellowship Scheme wherein engineering teachers from AICTE approved engineering institutions are sponsored to pursue research in CSIR/ DRDO/ DoS/ DAE laboratories leading to the award of a Ph.D degree in the chosen field of study and AICTE-INAE Travel Grant Scheme which provides financial support for engineering students to present papers abroad and provide a platform for showcasing work at international level.

As the only engineering Academy of the country, INAE represents India at the International Council of Academies of Engineering and Technological Sciences (CAETS); which is a premier non-governmental international organization comprising Member Academies from 30 countries across the world, with the objective of contributing to the advancement of science and technology and promoting sustainable economic growth of all nations. The CAETS 2015 Convocation on "*Pathways to Sustainability: Energy, Mobility and Healthcare Engineering*" was held for the first time in India in October 2015 at New Delhi which was inaugurated by Dr. Harsh Vardhan, Hon'ble Minister of Science & Technology and Earth Sciences. The Convocation was a grand success and attended by over 350 participants from 24 countries. INAE organizes joint events with some CAETS Member Academies on topics of mutual interest. The 3<sup>rd</sup> INAE-NAEK, Korea Workshop on "High Temperature Materials and System Engineering for Aerospace, Power Generation and Defense Industry" held in July 2019 at Hyderabad.

After a presentation of a summary of the important activities of the Academy, I wish to inform that INAE had received a letter from DST in August 2019 to the effect that INAE has been advised to recast its Memorandum of Association (MoA), as per a model MoA recommended by DST in order to make the affairs of INAE regular and in conformity with the provisions of Government/CAG with respect to rules/regulations/ guidelines which are applicable to Autonomous Bodies, which have been receiving grants from DST. This important issue was discussed during the Special General Meeting of

Fellows held in December 2019 at Jaipur. I am pleased to inform that the draft documents have since been approved by the Governing Council for forwarding of the same to DST for consideration.

As suggested by DST the INAE Vision 2020-25 Document has also been prepared which gives the Technological Roadmap of thrust areas for the next 5 years. Your support is sought in planning activities under this Technological Roadmap. All above activities have been realized with the active and noteworthy contributions of the INAE Fellows and the same are acknowledged not only by the Academy, but these efforts have been acclaimed at the highest national levels. I seek your continued co-operation and commitment in the future activities of INAE, some of which have been deferred due to the current situation in the face of the COVID -19 Pandemic. It is our genuine wish that the country and the world recover from the present health threats and that life resumes to normalcy and that the Academy may plan the conduct of the deferred events at the earliest possible. My best wishes to you and your families for good health and hope that you may be safe and secure in this crisis situation, which I pray gets over at an early date.

Yours sincerely,



(Dr Sanak Mishra)



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## अध्यक्ष/President

Formerly: Managing Director, Rourkela Steel Plant;

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AICTE - INAE Distinguished Visiting Professor

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### Sub : Commitment of Indian National Academy of Engineering (INAE) to the Efforts of Government of India towards Containment & Eradication of Pandemic COVID-19

Esteemed Dr. PK Mishra,

Greetings from Indian National Academy of Engineering (INAE).

INAE is the only Engineering Academy of the Nation and comprises India's most distinguished engineers, engineer-scientists and technologists.

On behalf of INAE and myself, I wish to convey our utmost admiration in the exemplary manner in which measures have been taken by the Government of India under the inspired leadership of the Hon'ble Prime Minister, towards the containment and eradication of the COVID-19 pandemic. It is a matter of pride that the nation has full confidence in the Government initiatives encompassing provision of medical services and facilities; promotion of indigenous medical testing facilities; development of cost-effective medical equipment; excellent governance; economic relief measures; repatriating Indian citizens from affected countries; appropriate education of citizens; timely lock-down of the country and ensuring essential supplies and facilities across the country.

It is my honour to give a brief introduction of INAE and its activities. It was founded in 1987 and is an autonomous institution supported through grant-in-aid(s) by the Department of Science & Technology, Government of India. INAE functions as an apex body and promotes the practice of engineering and technology for their application to solving problems of national importance. It also provides a forum for futuristic planning of India's much needed engineering and technological inputs and brings together specialists from such fields as may be necessary for comprehensive solutions to the needs of the Nation.

As President, of INAE, I humbly submit that INAE commits itself to extend all and any support required by the Government for the furtherance of its initiatives and measures for the containment and eradication of the COVID-19 pandemic. It would indeed be a matter of honour for the Academy to be called upon to contribute to the ongoing and novel measures and innovative strategies being undertaken by the Government of India.

We look forward to your valuable guidance.

With warm regards,

Yours sincerely,

Dr Sanak Mishra

Dr Pramod Kumar Mishra

Principal Secretary to the Prime Minister,

PMO, South Block

New Delhi - 110011





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**Subject: Urgent preparation of list of Experts on various aspects of COVID-19 as  
Engineers/Engineer Scientists/ Technologists for Government agencies like DST**

Dear Colleague,

As you are all aware, the world is facing an imminent crisis in the spreading of the COVID-19 pandemic and all affected nations are taking measures to mitigate the effects of this crisis.

It is a matter of pride that the Government of India has taken timely and innovative measures encompassing all sectors towards the containment and eradication of the COVID-19 pandemic so as to minimize the loss to the citizens and the nation, as a result of its fallout.

In this regard, I wish to convey that INAE has been advised to prepare a list of Experts who can deal with the various aspects of COVID-19 as Engineers/Engineer Scientists/ Technologists and plans to send this list to the Government agencies like DST, who would seek their engineering/technical advice and contributions. The Fellows and Young Associates of INAE from Academia, R&D and Industry categories have rich expertise encompassing all disciplines of engineering. It would indeed be befitting if INAE being the only engineering Academy in the country gets associated and makes meaningful contributions to the various measures and initiatives of the Government by providing the pertinent technical inputs to synergize the efforts, with innovative engineering interventions and providing consultancy in concerned fields.

In case any Fellow or Young Associate with substantial expertise, desires to get associated with the above activity, they may send their names, affiliation, full contact address and elaboration of their relevant area of expertise in maximum one page, as soon as possible to INAE for further follow-up actions with Department of Science & Technology.

We request your inputs at the earliest, though not later than April 4, 2020.

With warm and personal regards,

Yours sincerely,

(Dr Sanak Mishra)

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INAE Fellows and Young Associates



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**अध्यक्ष/President**

INAE/121/RI

April 7, 2020

**Sub: A Note on Recent Initiatives of INAE for meeting the  
National Needs and Strategic Priorities**

Dear Dr. Saraswat,

As you may be already aware, the Indian National Academy of Engineering (INAE) is an autonomous institution supported partly through grant-in-aid by Department of Science & Technology, Government of India. INAE was founded in 1987 and comprises India's most distinguished engineers and technologists covering the entire spectrum of engineering disciplines. It was established with the mission of providing vital inputs to the planning for the country's development, particularly related to engineering and technology. INAE functions as an apex body and promotes excellence in engineering & technology for their application to solving problems of national importance.

The Academy honours Indian and Foreign nationals for recognition of their personal achievements in "Engineering" which are of exceptional merit and distinctive eminence in the new and developing fields of technology. INAE currently has 861 Fellows, 84 Foreign Fellows and 122 Young Associates, who are amongst the most eminent engineers and technologists, having a marked track record of achievements. Over the years, consistent with its mission, the Academy has made significant contributions submitting quality engineering solutions to the Government for developing India. INAE's activities include programmes on issues of technology policy and overall development for the benefit of society.

We are happy to enclose a Note highlighting the recent activities and achievements of INAE for your kind perusal.

Yours sincerely,

(Dr. Sanak Mishra)

To,  
Dr. VK Saraswat  
Member, NITI Aayog  
Yojana Bhawan  
Parliament Street  
New Delhi-110001  
Tel. 011-23096566/67



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**अध्यक्ष/President**

INAE/121/RI

April 7, 2020

**Sub: A Note on Recent Initiatives of INAE for meeting the  
National Needs and Strategic Priorities**

Dear Professor K VijayRaghavan,

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Yours sincerely,

(Dr. Sanak Mishra)

To,  
Prof K VijayRaghavan  
Principal Scientific Adviser to Govt. of India  
Vigyan Bhavan Annexe  
Maulana Azad Road  
New Delhi - 110011  
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April 7, 2020

**Sub: A Note on Recent Initiatives of INAE for meeting the  
National Needs and Strategic Priorities**

Dear Professor Ashutosh Sharma,

As you are aware, the Indian National Academy of Engineering (INAE) is an autonomous institution supported partly through grant-in-aid by Department of Science & Technology, Government of India. INAE was founded in 1987 and comprises India's most distinguished engineers and technologists covering the entire spectrum of engineering disciplines. It was established with the mission of providing vital inputs to the planning for the country's development, particularly related to engineering and technology. INAE functions as an apex body and promotes excellence in engineering & technology for their application to solving problems of national importance.

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Yours sincerely,

(Dr. Sanak Mishra)

To,  
Prof. Ashutosh Sharma  
Secretary, Department of Science & Technology, Government of India.  
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Telephone: +91-11-26562122/25/33/44, 26567373, 26962819

## **Indian National Academy of Engineering (INAE)**

### **Recent Initiatives of INAE for meeting the National Needs and Strategic Priorities**

INAE has been involved in the recent past in several initiatives which are of national importance. By and large these tasks are undertaken either based on the important national priorities or on the suggestions from various Government Departments like DST, NITI Aayog etc. The Academy has made considerable progress in some of the following areas and we are happy that as an Engineering Academy we are able to play a meaningful role in Nation building. The details on some of our contributions are summarised below.

#### **1. Regional Transport Aircraft**

With the announcement of the new civil aviation policy, and Udaan programme from the Government of India, the requirement for Regional Civil Aircraft in the Country is expected to become substantially higher in the coming years. Therefore, it was felt necessary to build a sound base for design and development of a Regional Transport Aircraft industry in the Country. Accordingly, Indian National Academy of Engineering (INAE) organised a high-level meeting with the presence of the top executives from all stake holders like, HAL, NAL, CSIR, ISRO, other subject experts and also experts from Industries like Tata and Mahindra. All pertinent issues related to the topic were discussed in detail and converged on a possible mechanism for managing the Civil Aircraft programme in the Country. This was also taken up as one of the themes during Engineers Conclave-2017, which is a flagship event of INAE. The fifth Engineers Conclave in 2017 organized jointly with CSIR-NAL, Bangalore addressed this issue on "Regional Air Connectivity" in detail. Further in association with the Ministry of Defence Production and Ministry of Civil Aviation INAE organized a one-day International Seminar on "Civil Aviation – Regional Air Connectivity" as a part of Aero India on 21st February, 2019 at Bangalore.

The recommendations had since been finalized and attempts were made to reach out to the right agencies in the Country. Presentations were made to NITI Aayog and implementation of recommendation on instituting a Special Purpose Vehicle are under progress. A note was also prepared and forwarded to the Secretary, Ministry of Civil Aviation through the office of Principal Scientific Advisor (PSA) to Govt of India.

On January 14, 2020, a meeting of INAE Delegation comprising of Dr Sanak Mishra, President, INAE; Dr BN Suresh, Immediate Past -President, INAE; Dr Kota Harinarayana, Former DG, ADA; Dr PS Goel, Former President, INAE and Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE was held with Hon'ble Minister of Civil Aviation, Shri Hardeep Singh Puri at New Delhi, to present the recommendations on the development of Regional Transport Aircraft in the country,

emanated from the various technical activities organized by INAE on the subject. The meeting was fruitful and relevant in the context of India having the largest market in the world for the class of Regional Transport Aircraft with 90-seater capacity. The Hon'ble Minister directed Directorate General of Civil Aviation (DGCA) officials participating in the meeting to slot a one-hour presentation on the subject shortly.

## **2. Study on “Pilot Project on Safe Laboratory Practices and Laboratory Waste Disposal”**

During one of the DST-INAЕ Consultative Committee Meeting, Prof. Ashutosh Sharma, Secretary, DST suggested INAE to undertake a Study to create an action plan for enhancing the awareness of health and safety issues and safe disposal of chemicals and solvents in chemical and biological laboratories in Indian universities, research institutes and colleges. Accordingly, INAE organized one day workshop with all stakeholders at Pune and further undertook a Study on “Pilot Project on Safe Laboratory Practices and Laboratory Waste Disposal”.

The Study was carried out by Dr. S Sivaram, FNAE as the Principal Engineering Investigator (PI) and Dr. G.S. Grover, Chief Scientist (Retd), CSIR-National Chemical laboratory, Pune; as Team Member and Consultant and Mr. Shankar B. Kausley, TCS Pune as Team member. As a pilot project, three institutes were identified to create an implementable action plan as well as establish best practices for the disposal of chemical and hazardous wastes in the chemical and biological laboratories. The three institutes identified for undertaking of the study are:

1. Savitribai Phule Pune University (SPPU), Pune
2. Institute of Chemical Technology (ICT), Mumbai
3. Indian Institute of Science Education and Research (IISER), Kolkata

Other than the above mentioned three institutes, the inputs were also received from other institutes who are doing a remarkable work in this area viz IIT Delhi which has developed a zero-waste campus wherein the entire waste is being used to generate bio fuel to run the vehicles within the campus and carry out other activities. A report on the proposed pilot project on Safe Laboratory Practices and Laboratory Waste Disposal, along with the project proposal, after duly incorporating all suggestions has since been prepared and submitted to Prof. Ashutosh Sharma, Secretary, DST for consideration and allotting a time slot for making a presentation on the subject.

## **3. Clean Coal Technologies**

Department of Science and Technology (DST) had requested INAE to provide engineering interventions required for research in the field of ‘Clean Coal Technologies’. Accordingly, a Round Table meeting on “Clean Coal Technologies in India: Current Status, Demands and Aspirations – Pathways to Achievements” was conducted in June 2016 wherein about 35 domain experts from Industry, Academia and R&D participated. Based on the deliberations, the topics requiring technical interventions and the domain experts were identified. During the final session of the workshop, it was decided to prepare a comprehensive report highlighting the specific areas, gaps if any, and further actions needed to bridge the gaps, including the

identification of research areas where further funding can be considered. The specialists were also identified to prepare the report and the inputs have since been obtained from the authors on the topics identified during the subject Round Table. The meeting to finalize the comprehensive report containing inputs from all the authors on the selected topics in the area of Clean Coal Technologies identified earlier; was held on Oct 26, 2016 at New Delhi. The meeting was attended by 25 experts in the area of Clean Coal technologies. Based on the deliberations, the areas for undertaking research had been identified and the report along with 11 proposals for R&D projects submitted to DST. DST is funding some of the research proposals based on the recommendations of INAE.

#### **4. Engineers Conclaves**

Engineers Conclave is one of the very important initiatives started in 2013 by INAE essentially to find the engineering solutions to many of the problems faced by society and the Country. These Conclaves are organised in collaboration with major engineering institutions/strategic departments, on rotation basis, each year. Two important themes which are of National importance are selected for each Conclave and the deliberations are carefully structured to recommend suitable engineering solutions. Specific actionable recommendations are formulated and submitted to the concerned government department and industry for implementation. Engineers Conclave has tangible delivery in suggesting possible engineering solutions to the policy makers of the country. Some of the important themes where INAE has made tangible recommendations are Smart Cities, Engineering Education, Regional Transport Aircraft, Green Energy Solutions, etc.

#### **5. Frugal Innovation (National Innovation Council, DST)**

Considering the importance of promoting the innovation in the Country INAE undertook an initiative to give thrust to frugal innovation. Besides the core activities of INAE, one of the objectives of the Academy is to pursue academic activities to addressing 'Engineering challenges' that the country is facing. In line with this objective INAE undertook one of the major initiatives of organising a two-day Workshop jointly with National Institute of Rural Development and Panchayat Raj (NIRDPR) on Frugal Innovation on July 7-8, 2017 at NIRDPR, Hyderabad.

Further a "Frugal Innovation Nurturing Programme" (FINP) was instituted under the aegis of INAE in August 2018 with an objective to nurture prospective frugal innovations which have reached prototype stage to scale up and commercialize them for greater exploitation. For this purpose, Innovation Promotion Committee (IPC) was constituted for implementation of the Programme under the Chairmanship of Dr. V Bhujanga Rao, FNAE. Frugal Innovation Nurturing Programme (FINP) has also joined hands with National Innovation Foundation (NIF) to identify some innovations that have reached prototype stage and have been successfully tried in the field, but were limited in out-reach in terms of infrastructure/means available with the inventor. Frugal Innovation Nurturing Programme (FINP) has since identified four such innovations during 2018-19 and one of them was scaled up from TRL-4 to TRL-9. After gaining experience in 2018-19, this year in 2019-20, 13 such innovations have been identified for greater exploitation and commercialization.

## **6. Role of Hydrogen in India's Energy Strategy**

Prof. K VijayRaghavan, Principal Scientific Adviser (PSA) to Govt. of India on the sidelines of the R&D Conclave held on 17December 2019 in Delhi expressed his willingness that INAE should prepare a concept paper on Hydrogen based approach for India's Energy Strategy. For this a Round Table Interaction of domain experts on "Role of Hydrogen in India's Energy Strategy" was organized by INAE Pune Local Chapter on February 15, 2020 at Pune, which was attended by domain experts from INAE, Academia, R&D organizations and Industry. The invited experts shared insights on the current and future global situation about use of Hydrogen as an energy source; discussed the overall situation in India with respect to technologies, capabilities and affordability for Generation, Storage, Transportation and Usage of Hydrogen and concluded on the approach to be followed by INAE in forwarding recommendations to the Government. Subsequent to the deliberations, the recommendations in the form of a White Paper containing all the pertinent issues related to Role of Hydrogen in India's Energy Strategy are under compilation and shall be submitted to Prof. K VijayRaghavan, Principal Scientific Adviser (PSA) to Govt. of India



# **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

## **INAE Mission**

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

## **Technological Roadmap**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

### **3. Excellence in Engineering Education**

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

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

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

It is important that the professional ethics is part of the engineering course curricula. A multi-disciplinary systems perspective to all engineers will certainly broaden their horizons – much needed

to face the emerging world scenario. Good communication skills and ability to work in teams, are also prerequisites for engineers to succeed in the real life.

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

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

#### **4. World Class Infrastructure**

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

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

#### **5. Cyber-physical Systems**

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

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

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

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

### Civil Engineering

#### 1. **New Low-Cost Approach Detects Building Deformations with Extreme Precision in Real Time**

A new camera-based method for measuring building deformations can detect small displacements from 10 meters away. The method could be useful for continuously detecting fast deformations in high-rise buildings, bridges and other large structures with the aim of adapting these structures to external forces. "Our new approach to detect building deformations could be used to continuously monitor movements. For bridges, the measured deformations could be used to counteract external loads such as a truck traversing the bridge, thereby increasing the lifetime of the bridge," said Flavio Guerra from the University of Stuttgart, a member of the research team. "Because it operates in real time, it could be used to set off an alert the moment any new deformations -- which can lead to cracks -- were detected." The research was conducted as part of a project that aims to develop the technology necessary to create buildings that adapt to environmental conditions such as sunlight, air temperature, wind and earthquakes. "One day we could have lightweight buildings that change forms in response to complex wind forces and can stay still during an earthquake," said Guerra. "This type of adaptation requires extremely precise building deformation measurement so that the building's current state is estimated and the direction in which it will likely move can be predicted." The new method involves fixing a camera on a tripod a small distance away from the front of the building and attaching small light emitters to the building. The camera then detects whether the light sources move relative to each other. A computer-generated hologram is used to create multiple copies of each light source image on the image sensor. Averaging the movement of the multiple copies of the laser spot helps decrease measurement errors, such as noise, yielding measurement uncertainties below a hundredth of a pixel. Using multiple cameras would improve that accuracy even more and enable the technique to be used on very large structures. Although fiber optic sensors can be used for structural health monitoring, they must be installed when the building is built. The new camera-based system can be attached after construction and uses hardware that is less expensive than fiber optic systems. "The multi-point measurement approach we used is based on a relatively simple method developed for the control of coordinate measurement machines," said Guerra. "However, we applied the multi-point method for the first time on large objects outdoors under changing environmental conditions in real-time." The researchers point out that most camera inspection systems illuminate the object -- a building in this case -- and then image it with a camera. They took a different approach by attaching light emitters to the building and directing the light directly toward the camera. This setup allows faster and more accurate measurements because the camera receives more light. The researchers used their new method to monitor very small movements of an adaptive building prototype frame 9 meters tall. Their measurements matched well with vibrometer and strain gauge sensor data obtained for the prototype. Next, the researchers plan to use the system to measure movement in real buildings. They also plan to make the software more robust and redundant so that it is reliable for continuous measurement 24 hours a day.

Source <https://www.sciencedaily.com/releases/2020/03/200316141600.htm>

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### **2. Powerful New AI Technique Detects and Classifies Galaxies in Astronomy Image Data**

Researchers at UC Santa Cruz have developed a powerful new computer program called Morpheus that can analyze astronomical image data pixel by pixel to identify and classify all of the galaxies and stars in large data sets from astronomy surveys. Morpheus is a deep-learning framework that incorporates a variety of artificial intelligence technologies developed for applications such as image and speech recognition. Brant Robertson, a professor of astronomy and astrophysics who leads the Computational Astrophysics Research Group at UC Santa Cruz, said the rapidly increasing size of astronomy data sets has made it essential to automate some of the tasks traditionally done by astronomers. "There are some things we simply cannot do as humans, so we have to find ways to use computers to deal with the huge amount of data that will be coming in over the next few years from large astronomical survey projects," he said. The morphologies of galaxies, from rotating disk galaxies like our own Milky Way to amorphous elliptical and spheroidal galaxies, can tell astronomers about how galaxies form and evolve over time. Large-scale surveys, such as the Legacy Survey of Space and Time (LSST) to be conducted at the Vera Rubin Observatory now under construction in Chile, will generate huge amounts of image data, and Robertson has been involved in planning how to use that data to understand the formation and evolution of galaxies. LSST will take more than 800 panoramic images each night with a 3.2-billion-pixel camera, recording the entire visible sky twice each week. Other astronomers have used deep-learning technology to classify galaxies, but previous efforts have typically involved adapting existing image recognition algorithms, and researchers have fed the algorithms curated images of galaxies to be classified. Hausen built Morpheus from the ground up specifically for astronomical image data, and the model uses as input the original image data in the standard digital file format used by astronomers. Pixel-level classification is another important advantage of Morpheus, Robertson said. "With other models, you have to know something is there and feed the model an image, and it classifies the entire galaxy at once," he said. "Morpheus discovers the galaxies for you, and does it pixel by pixel, so it can handle very complicated images, where you might have a spheroidal right next to a disk. For a disk with a central bulge, it classifies the bulge separately. So it's very powerful." To train the deep-learning algorithm, the researchers used information from a 2015 study in which dozens of astronomers classified about 10,000 galaxies in Hubble Space Telescope images from the CANDELS survey. They then applied Morpheus to image data from the Hubble Legacy Fields, which combines observations taken by several Hubble deep-field surveys. When Morpheus processes an image of an area of the sky, it generates a new set of images of that part of the sky in which all objects are color-coded based on their morphology, separating astronomical objects from the background and identifying point sources (stars) and different types of galaxies. The output includes a confidence level for each classification. Running on UCSC's lux supercomputer, the program rapidly generates a pixel-by-pixel analysis for the entire data set. "Morpheus provides detection and morphological classification of astronomical objects at a level of granularity that doesn't currently exist," Hausen said. An interactive visualization of the Morpheus model results for GOODS South, a deep-field survey that imaged millions of galaxies, has been publicly released.

Source <https://www.sciencedaily.com/releases/2020/05/200512151951.htm>

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## Mechanical Engineering

### 3. New Army 3-D Printing Study Shows Promise for Predictive Maintenance

Army researchers have discovered a way to monitor the performance of 3-D printed parts, which tend to have imperfections that affect performance in ways traditionally-machined parts do not. A new study showed that the Army could detect and monitor the wear and tear of 3-D printed maraging steel through sensor measurement. These types of measurements help Soldiers maintain readiness because these indicators help predict when parts will degrade or fail, and need replacement. "3-D printed parts display certain attributes, due to the manufacturing process itself, which, unchecked, may cause these parts to degrade in manners not observed in traditionally-machined parts," said Dr. Jaret C. Riddick, director of the Vehicle Technology Directorate at the U.S. Army's Combat Capabilities Development Command's Army Research Laboratory. "Because of this, it's commonly understood that the use of these parts, in current cases, is meant to be a stop-gap to fill a critical need just as we have seen with 3-D printing during the COVID-19 response." He said the laboratory's study points to scientific discovery that ensures readiness in increasingly contested environments where the immediate need for replacement parts places constraints on the time it takes to deliver them from far away. In these cases, Soldiers would opt for a stop-gap to continue the mission rather having to abort the mission. The team of researchers likened cues from the material's performance to a vehicle odometer reading that signals a need for an oil change. "The strain or eddy current sensor would supply a measurement and let you know the part needs replaced," said Dr. Todd C. Henry, a mechanical engineer at the laboratory who co-authored the study. Henry wants to develop a tool for measuring the unique performance of each 3-D printed part acknowledging that each is different via sensor measurement. "If I took a batch of paper clips and started bending them back and forth they'll break from fatigue damage at different intervals depending on the internal imperfections associated with the steel," Henry said. "Every real-world material and structure has imperfections that make it unique in terms of performance so if the batch of paper clips take 21-30 cycles to break, what we would do today is after 15 cycles throw the batch of paperclips away to be safe." He said the imperfections in 3-D printed parts are typically attributed to voids and geometric variance between the computer model and the print. Sensor technology he's developing offers a way to track individual parts, predict failure points and replace them a few cycles before they break. "In order to create a high trust situation, you take little risk such as throwing the paper clip away after 15 cycles even though the lowest lifetime in your test batch was 21. If you try and take more risk and put the throw away limit at 22 cycles then the paperclip may break on someone sometime but you will save money." The research team conducted an experimental validation set for assessing the real-time fatigue behaviour of metallic additively manufactured maraging steel structures. Army researchers are applying these findings to new studies to 3-D-printing of stainless steel parts and using machine-learning techniques, instead of sensors, to characterize the life of parts, Henry said. "With 3-D printing, you might not be able to replace a part with the exact same material," he said. "There is a cost and time benefit with 3-D printing that perhaps warrants using it anyway. Imagine a situation where you always chose the strongest material but there was another material that was cheaper and easier to get however you need to prove that this other material can be depended on." This study is as much about understanding the specific performance of a 3-D-printed material as it is about understanding our ability to monitor and detect performance and 3-D-printed material degradation, Henry said.

Source <https://www.sciencedaily.com/releases/2020/05/200521151921.htm>

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## Chemical Engineering

### 4. Chemical Recycling Makes Useful Product from Waste Bioplastic

A faster, more efficient way of recycling plant-based "bioplastics" has been developed by a team of scientists at the Universities of Birmingham and Bath. The team has shown how their chemical recycling method not only speeds up the process, it can also be converted into a new product -- a biodegradable solvent -- which can be sold for use in a wide variety of industries including cosmetics and pharmaceuticals. Bioplastics, made from polylactic acid (PLA), are becoming increasingly common in products such as disposable cups, packaging materials and even children's toys. Typically, once they reach the end of their useful life, they are disposed of in landfill or composted, biodegrading over periods of up to several months. In a new study, researchers have shown that a chemical process, using a zinc-based catalyst developed at the University of Bath and methanol, can be used to break down real consumer plastics and produce the green solvent, called methyl lactate. The team tested their method on three separate PLA products- a disposable cup, some 3D printer waste, and a children's toy. They found the cup was most easily converted to methyl lactate at lower temperatures, but even the bulkier plastic in the children's toy could be converted using higher temperatures. "We were excited to see that it was possible to obtain high quantities of the green solvent regardless of samples' characteristics due to colorants, additives, sizes and even molecular weight.," said lead author Luis Román-Ramírez of the University of Birmingham's School of Chemical Engineering. Lead researcher Professor Joe Wood, at the University of Birmingham, says: "The process we've designed has real potential to contribute to ongoing efforts to reduce the amount of plastic going into landfill or being incinerated creating new valuable products from waste. "Our technique breaks down the plastics into their chemical building blocks before 'rebuilding' them into a new product, so we can guarantee that the new product is of sufficiently high quality for use in other products and processes." The chemical process has been tried up to 300 ml, so next steps would include scaling up the reactor further before it can be used in an industrial setting.

Source <https://www.sciencedaily.com/releases/2020/05/200520191424.htm>

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## Electrical Engineering

### 5. World's Fastest Internet Speed from a Single Optical Chip

Researchers from Monash, Swinburne and RMIT universities have successfully tested and recorded Australia's fastest internet data speed, and that of the world, from a single optical chip -- capable of downloading 1000 high definition movies in a split second. These findings have the potential to not only fast-track the next 25 years of Australia's telecommunications capacity, but also the possibility for this home-grown technology to be rolled out across the world. In light of the pressures being placed on the world's internet infrastructure, recently highlighted by isolation policies as a result of COVID-19, the research team led by Dr Bill Corcoran (Monash), Distinguished Professor Arnan Mitchell (RMIT) and Professor David Moss (Swinburne) were able to achieve a data speed of 44.2 Terabits per second (Tbps) from a single light source. This technology has the capacity to support the high-speed internet connections of 1.8 million households in Melbourne, Australia, at the same time, and billions across the world during peak periods. Demonstrations of this magnitude are usually confined to a laboratory. But, for this study, researchers achieved these quick speeds using existing communications infrastructure where they were able to efficiently load-test the network. They used a new device that replaces 80 lasers with one single piece of equipment known as a micro-comb, which is smaller and lighter than existing telecommunications hardware. It was planted into and load-tested using existing infrastructure, which mirrors that used by the NBN. It is the first time any micro-comb has been used in a field trial and possesses the highest amount of data produced from a single optical chip. "We're currently getting a sneak-peak of how the infrastructure for the internet will hold up in two to three years' time, due to the unprecedented number of people using the internet for remote work, socialising and streaming. It's really showing us that we need to be able to scale the capacity of our internet connections," said Dr Bill Corcoran, co-lead author of the study and Lecturer in Electrical and Computer Systems Engineering at Monash University. "What our research demonstrates is the ability for fibres that we already have in the ground, thanks to the NBN project, to be the backbone of communications networks now and in the future. We've developed something that is scalable to meet future needs. This data can be used for self-driving cars and future transportation and it can help the medicine, education, finance and e-commerce industries. To illustrate the impact optical micro-combs have on optimising communication systems, researchers installed 76.6km of 'dark' optical fibres between RMIT's Melbourne City Campus and Monash University's Clayton Campus. The optical fibres were provided by Australia's Academic Research Network. Within these fibres, researchers placed the micro-comb -- contributed by Swinburne University, as part of a broad international collaboration -- which acts like a rainbow made up of hundreds of high quality infrared lasers from a single chip. Each 'laser' has the capacity to be used as a separate communications channel. Researchers were able to send maximum data down each channel, simulating peak internet usage, across 4THz of bandwidth. Distinguished Professor Mitchell said reaching the optimum data speed of 44.2 Tbps showed the potential of existing Australian infrastructure. The future ambition of the project is to scale up the current transmitters from hundreds of gigabytes per second towards tens of terabytes per second without increasing size, weight or cost. "Long-term, we hope to create integrated photonic chips that could enable this sort of data rate to be achieved across existing optical fibre links with minimal cost," Distinguished Professor Mitchell said. "Initially, these would be attractive for ultra-high speed communications between data centres. However, we could imagine this technology becoming sufficiently low cost and compact that it could be deployed for commercial use by the general public in cities across the world." "It is truly exciting to see their capability in ultra-high bandwidth fibre optic telecommunications coming to fruition. This work represents a world-record for bandwidth down a single optical fibre from a single chip source, and represents an enormous breakthrough for part of the network which does the heaviest lifting. Micro-combs offer enormous promise for us to meet the world's insatiable demand for bandwidth" a lead researcher said.

Source <https://www.sciencedaily.com/releases/2020/05/200522095504.htm>

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### 6. Researchers Boost Microwave Signal Stability a Hundredfold

Researchers at the National Institute of Standards and Technology (NIST) have used state-of-the-art atomic clocks, advanced light detectors, and a measurement tool called a frequency comb to boost the stability of microwave signals 100-fold. This marks a giant step toward better electronics to enable more accurate time dissemination, improved navigation, more reliable communications and higher-resolution imaging for radar and astronomy. Improving the microwave signal's consistency over a specific time period helps ensure reliable operation of a device or system. The work transfers the already superb stability of the cutting-edge laboratory atomic clocks operating at optical frequencies to microwave frequencies, which are currently used to calibrate electronics. Electronic systems are unable to directly count optical signals, so the NIST technology and techniques indirectly transfer the signal stability of optical clocks to the microwave domain. In their setup, the researchers used the "ticking" of two of NIST's ytterbium lattice clocks to generate light pulses, as well as frequency combs serving as gears to translate the higher-frequency optical pulses accurately into lower-frequency microwave signals. Advanced photodiodes converted light pulses into electrical currents, which in turn generated a 10 gigahertz (GHz, or a billion cycles per second) microwave signal that tracked the clocks' ticking exactly, with an error of just one part in a quintillion (1 followed by 18 zeros). This performance level is on par with that of both optical clocks and 100 times more stable than the best microwave sources. "Years of research, including important contributions from NIST, have resulted in high-speed photodetectors that can now transfer optical clock stability to the microwave domain," lead researcher Frank Quinlan said. "The second major technical improvement was in the direct tracking of the microwaves with high precision, combined with lots of knowhow in signal amplification." Optical waves have shorter, faster cycles than microwaves do, so they have different shapes. In converting stable optical waves to microwaves, the researchers tracked the phase -- the exact timing of the waves -- to ensure they were identical, and not shifted relative to one another. The experiment tracked phase changes with a resolution corresponding to just one millionth of a cycle. "This is a field where just doubling microwave stability can take years or decades to achieve," group leader Chris Oates said. "A hundred times better is almost unfathomable." Some components of the NIST system, such as the frequency combs and detectors, are ready to be used in field applications now, Quinlan said. But NIST researchers are still working on transferring state-of-the-art optical clocks to mobile platforms. The ytterbium clocks, which operate at frequencies of 518 terahertz (trillion cycles per second), currently occupy large tables in highly controlled laboratory settings. Ultra-stable electronic signals could support widespread applications, including future calibration of electronic clocks, such as electric devices powered by oscillating quartz crystals. This is an important consideration for the redefinition of the international time standard, the SI second, now based on the microwave frequencies absorbed by the cesium atoms in conventional clocks. In the coming years, the international scientific community is expected to select a new time standard based on optical frequencies that other atoms, such as ytterbium, absorb. Super-stable signals could also make wireless communications systems more reliable. Optically derived electronic signals could make imaging systems more sensitive. Radar sensitivity, particularly for slow-moving objects, is now limited by microwave noise and could be greatly enhanced. New photodiodes, produced in a collaboration between NIST and the University of Virginia, convert the optical signals to microwave signals more predictably and with lower noise than earlier designs. In addition, microwaves could carry signals from distant optical clocks for applications in navigation and fundamental physics research. Astronomical imaging and relativistic geodesy, which measures the Earth's gravitational shape, are now based on detecting microwave signals at receivers around the world and combining them to form images of objects. Remote calibration of these receivers could make it possible to move the network from Earth into space, which would enhance image resolution and avoid atmospheric distortions that limit observation time. With hours of observing time instead of seconds, researchers could image many more objects.

## Aerospace Engineering

### 7. Fossil Fuel-Free Jet Propulsion with Air Plasmas

Humans depend on fossil fuels as their primary energy source, especially in transportation. However, fossil fuels are both unsustainable and unsafe, serving as the largest source of greenhouse gas emissions and leading to adverse respiratory effects and devastation due to global warming. A team of researchers at the Institute of Technological Sciences at Wuhan University has demonstrated a prototype device that uses microwave air plasmas for jet propulsion. "The motivation of our work is to help solve the global warming problems owing to humans' use of fossil fuel combustion engines to power machinery, such as cars and airplanes," said author Jau Tang, a professor at Wuhan University. "There is no need for fossil fuel with our design, and therefore, there is no carbon emission to cause greenhouse effects and global warming." Beyond solid, liquid and gas, plasma is the fourth state of matter, consisting of an aggregate of charged ions. It exists naturally in places like the sun's surface and Earth's lightning, but it can also be generated. The researchers created a plasma jet by compressing air into high pressures and using a microwave to ionize the pressurized air stream. This method differs from previous attempts to create plasma jet thrusters in one key way. Other plasma jet thrusters, like NASA's Dawn space probe, use xenon plasma, which cannot overcome the friction in Earth's atmosphere, and are therefore not powerful enough for use in air transportation. Instead, the authors' plasma jet thruster generates the high-temperature, high-pressure plasma in situ using only injected air and electricity. The prototype plasma jet device can lift a 1-kilogram steel ball over a 24-millimeter diameter quartz tube, where the high-pressure air is converted into a plasma jet by passing through a microwave ionization chamber. To scale, the corresponding thrusting pressure is comparable to a commercial airplane jet engine. By building a large array of these thrusters with high-power microwave sources, the prototype design can be scaled up to a full-sized jet. The authors are working on improving the efficiency of the device toward this goal. "Our results demonstrated that such a jet engine based on microwave air plasma can be a potentially viable alternative to the conventional fossil fuel jet engine," Tang said.

Source <https://www.sciencedaily.com/releases/2020/05/200505121705.htm>

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## Mining, Metallurgical and Materials Engineering

### 8. Graphene-Reinforced Carbon Fiber May Lead to Affordable, Stronger Car Materials

A new way of creating carbon fibers -- which are typically expensive to make -- could one day lead to using these lightweight, high-strength materials to improve safety and reduce the cost of producing cars, according to a team of researchers. Using a mix of computer simulations and laboratory experiments, the team found that adding small amounts of the 2D graphene to the production process both reduces the production cost and strengthens the fibers. For decades, carbon fibers have been a mainstay of airplane production. If created in the right way, these long strands of carbon-based atoms, narrower than human hair, are lightweight, stiff and strong -- a perfect application for keeping passengers safe in a vehicle soaring miles above the ground. "Even though carbon fibers have really nice features, they would make a car far more expensive" with the way carbon fibers are manufactured now, said Adri van Duin, professor of mechanical and chemical engineering, Penn State. "If you can get these properties easier to manufacture then you can make cars significantly lighter, lower the cost of them and make them safer." Carbon fiber sells for about \$15 per pound in USA today, and the team, which includes researchers from Penn State, the University of Virginia and Oak Ridge National Laboratory, in collaboration with industry partners Solvay and Oshkosh, wants to reduce that to \$5 per pound by making changes to the complex production process. A lower production cost will increase carbon fiber's potential applications, including in cars. Further, the team's research may lower the cost of producing other types of carbon fibers, some of which sell for up to \$900 per pound today. "Currently most carbon fibers are produced from a polymer known as polyacrylonitrile, or PAN, and it is pretty costly," said Margorzata Kowalik, researcher in Penn State's Department of Mechanical Engineering. "The price of PAN makes up about 50% of the production cost of carbon fibers." PAN is used to create 90% of carbon fibers found in the market today, but its production requires an enormous amount of energy. First, PAN fibers have to be heated to 200-300 degrees Celsius to oxidize them. Next, they must be heated to 1,200-1,600 degrees Celsius to transform the atoms into carbon. Finally, they have to be heated to 2,100 degrees Celsius so that the molecules are aligned properly. Without this series of steps, the resulting material would lack its needed strength and stiffness. The team reported that adding trace amounts of graphene -- only 0.075% concentration by weight -- to the first stages of this process allowed the team to create a carbon fiber that had 225% greater strength and 184% greater stiffness than the conventionally made PAN-based carbon fibers. The team gleaned insight into the chemical reactions taking place through a series of small- and large-scale computer simulations conducted on several supercomputers, the Institute for Computational and Data Sciences (ICDS) Advanced CyberInfrastructure; the National Science Foundation (NSF)-funded CyberLAMP, which is maintained by ICDS; and the NSF-funded Extreme Science and Engineering Discovery Environment (XSEDE), a multi-institute network of supercomputers and related resources. They also studied the properties of each material using laboratories in Penn State's Materials Research Institute (MRI). The flat structure of graphene helps to align PAN molecules consistently throughout the fiber, which is needed in the production process. Further, at high temperatures graphene edges have a natural catalytic property so that "the rest of PAN condenses around these edges," said van Duin, a researcher. With the new knowledge gained from this study, the team is exploring ways to further use graphene in this production process using cheaper precursors, with a goal of cutting out one or more of the production steps altogether, thereby reducing costs even more.

Source <https://www.sciencedaily.com/releases/2020/05/200518144847.htm>

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## Energy Engineering

### 9. Six-Junction Solar Cell Sets Two World Records for Efficiency

Scientists at the National Renewable Energy Laboratory (NREL) have fabricated a solar cell with an efficiency of nearly 50%. The six-junction solar cell now holds the world record for the highest solar conversion efficiency at 47.1%, which was measured under concentrated illumination. A variation of the same cell also set the efficiency record under one-sun illumination at 39.2%. "This device really demonstrates the extraordinary potential of multijunction solar cells," said John Geisz, a principal scientist in the High-Efficiency Crystalline Photovoltaics Group at NREL and lead author of a new paper on the record-setting cell. To construct the device, NREL researchers relied on III-V materials -- so called because of their position on the periodic table -- that have a wide range of light absorption properties. Each of the cell's six junctions (the photoactive layers) is specially designed to capture light from a specific part of the solar spectrum. The device contains about 140 total layers of various III-V materials to support the performance of these junctions, and yet is three times narrower than a human hair. Due to their highly efficient nature and the cost associated with making them, III-V solar cells are most often used to power satellites, which prize III-V's unmatched performance. On Earth, however, the six-junction solar cell is well-suited for use in concentrator photovoltaics, said Ryan France, co-author and a scientist in the III-V Multijunctions Group at NREL. "One way to reduce cost is to reduce the required area," he said, "and you can do that by using a mirror to capture the light and focus the light down to a point. Then you can get away with a hundredth or even a thousandth of the material, compared to a flat-plate silicon cell. You use a lot less semiconductor material by concentrating the light. An additional advantage is that the efficiency goes up as you concentrate the light." France described the potential for the solar cell to exceed 50% efficiency as "actually very achievable" but that 100% efficiency cannot be reached due to the fundamental limits imposed by thermodynamics. Geisz said that currently the main research hurdle to topping 50% efficiency is to reduce the resistive barriers inside the cell that impede the flow of current. Meanwhile, he notes that NREL is also heavily engaged in reducing the cost of III-V solar cells, enabling new markets for these highly efficient devices.

Source <https://www.sciencedaily.com/releases/2020/04/200414173255.htm>

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**10. Implantable Biosensor Operates Without Batteries**

Researchers from the University of Surrey have revealed their new biodegradable motion sensor -- paving the way for implanted nanotechnology that could help future sports professionals better monitor their movements to aid rapid improvements, or help caregivers remotely monitor people living with dementia. The researchers detail how they developed a nano-biomedical motion sensor which can be paired with AI systems to recognise movements of distinct body parts. The ATI's technology builds on its previous work around triboelectric nanogenerators (TENG), where researchers used the technology to harness human movements and generate small amounts of electrical energy. Combining the two means self-powered sensors are possible without the need for chemical or wired power sources. In their new research, the team from the ATI developed a flexible, biodegradable and long-lasting TENG from silk cocoon waste. They used a new alcohol treatment technique, which leads to greater durability for the device, even under harsh or humid environments. Dr. Bhaskar Dudem, project lead and Research Fellow at the ATI, said: "We are excited to show the world the immense potential of our durable, silk film based nanogenerator. It's ability to work in severe environments while being able to generate electricity and monitor human movements positions our TENG in a class of its own when it comes to the technology." Professor Ravi Silva, Director of the ATI, said: "We are proud of Dr Dudem's work which is helping the ATI lead the way in developing wearable, flexible, and biocompatible TENGs that efficiently harvest environmental energies. If we are to live in a future where autonomous sensing and detecting of pathogens is important, the ability to create both self-powered and wireless biosensors linked to AI is a significant boost."

Source <https://www.sciencedaily.com/releases/2020/05/200521115644.htm>

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## Engineering Innovation in India

### CSIR-Built Oxygen Enricher to be Scaled Up by Start-up



A membrane oxygenator equipment (MOE) developed by Council of Scientific & Industrial Research's (CSIR) National Chemical Laboratory in Pune will be scaled up by a government-funded start-up. With an urgent requirement of respiratory interventions to treat breathlessness — one of the critical symptoms of Covid-19 — the equipment can be used to treat patients who have been released from Intensive Care Units (ICU). The device can also be helpful for patients suffering with chronic breathing problems like Chronic Obstructive Pulmonary Disease (COPD), asthma, Interstitial Lung Disease (ILD), pre-term babies, snake bite, and so on. Genrich Membranes, a spin-off based on proprietary technology licensed from the Council of Scientific & Industrial Research's (CSIR) National Chemical Laboratory in Pune is funded by the Department of Science and Technology (DST). Based on innovative, indigenous hollow-fiber membrane technology, the MOE enriches oxygen in the air up to 35% under pressure (4-7 bar, using oil-free compressor). “The equipment consists of a membrane cartridge, oil-free compressor, output flowmeter, humidifier bottle, nasal-cannula, and tubing and fittings. The compressed, filtered air from the compressor is fed to the membrane cartridge, which selectively permeates oxygen over nitrogen offering oxygen-enriched air as the product at the ambient pressure,” the DST said. The membrane cartridge capable of distinguishing oxygen and nitrogen restricts the passage of viruses, bacteria, and particulate matter. The product air is of medical grade. The DST added that the device is safe, does not require trained manpower for its operation, needs minimum maintenance, is portable, compact, and with plug-and-play facility provides on-site, quick-start oxygen-enriched air. “Medical grade oxygen-enriched air is needed in a variety of patient care settings including Covid-19 situations where the global experience is about 14% infections require some kind of respiratory support, but only about 4% need ICU based ventilators. The rest of this population, as well as in many other conditions involving chronic breathing problems, this innovation promises to be of excellent,” said Prof Ashutosh Sharma, Secretary, DST. The testing and validation of the prototype have been demonstrated in a relevant environment and Genrich is planning to join hands with established medical device companies to mass manufacture MOE which can get this device ready, within three months.

Source <https://timesofindia.indiatimes.com/home/science/csir-built-oxygen-enricher-to-be-scaled-up-by-start-up/articleshow/75065807.cms>