Annual Report 2021-22

Indian National Academy of Engineering

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Indian National Academy of Engineering

Foreword

At the outset, I take this opportunity to convey my greetings and warm wishes to the Former Presidents, Council Members, Fellows, Foreign Fellows, Young Associates, Officials of INAE and Awardees for a happy, healthy and prosperous year ahead. It is heartening to see that the Covid-19 pandemic has abated, and we are inching towards normalcy with most of the events happening now either in physical or hybrid mode. We have reasons to be happy and proud at INAE with the multitude of activities, accomplishments and success in all our existing and new initiatives launched in the last financial year. I am also delighted to inform that INAE has been provided an office space at the DST Complex, Technology Bhawan, New Delhi and INAE office has since been operational from the DST Complex from August 2, 2021 onwards. We are particularly thankful to the Secretary DST on this count.

As informed earlier, subsequent to the launch of Azadi ka Amrit Mohotsav by the Government on 12th March 2021, the then Secretary, DST took a meeting with all the Autonomous Professional Bodies under DST on the same day and advised each one to draw a detailed plan for a grand 75-week long celebration of India's 75th anniversary of Independence until 15th August 2022. In this regard, a Task Force was constituted by INAE to design and monitor the specific programs that INAE would pursue in the next 75 weeks in different locations and occasions. Besides various functions at the Head Office and Chapters, INAE decided to publish two compendia on "Landmark Achievements in Engineering and Technology in Independent India" and "Women Engineers in India - Volume I" as a special tribute to this momentous occasion.

On the eve of its 35th Foundation Day on 20th April 2021, INAE organized a special event on online Special Lectures by the four Secretaries from DAE, DRDO, ISRO and CSIR on their biggest technological achievements and contributions that made India proud. The occasion also marked the inauguration of "Azadi Ka Amrit Mahotsav" celebration of INAE. Prof Ashutosh Sharma, erstwhile Secretary, DST as the Chief Guest, delivered the Inaugural Address. The event was well attended and widely publicized on social media.

For most part of the last year, the ongoing challenges of the pandemic had perforce made some of the flagship events to be conducted in online or hybrid mode. INAE organized the 15th National Frontiers of Engineering (NatFoE) Symposium jointly with IIT Hyderabad in July 2021 on virtual platform bringing together 50 bright young engineers to deliberate on emerging technologies in some key engineering sectors. Innovation in Manufacturing Processes (IMP), which is a national level project competition open to all engineering students and research scholars was also conducted by INAE and IIT Hyderabad jointly as a satellite event along with 15th NatFoE symposium.

The 4th INAE Youth Conclave 2021 was organized by INAE jointly with IIT Bombay; NITIE, Mumbai and ICT, Mumbai online for the first time in September 2021, which was well attended by INAE Fellows, Young Associates and Engineering Students from across the country. Similarly, Engineers Conclave 2021 (EC-2021) was organized online jointly with the International Solar Alliance (ISA) in October 2021. The two themes of EC-2021 were

"Engineering Challenges for de-carbonizing the Indian Economy" steered by ISA and "Achievements of Indian Engineering – Azadi ka Amrit Mahotsav" coordinated by INAE. Deliberations on both these themes culminated into extremely innovative and effective recommendations which are being pursued now in right earnestness.

The INAE Annual Convention 2021 organized virtually (online) for the second time in December 2021 maintaining the usual gaiety and grandeur albeit using a digital platform. Mr NR Narayana Murthy, Former Chairman Emeritus, Infosys Ltd and the Chief Guest of the Convention delivered a very thought-provoking lecture on the topic "Creating a culture to solve grand engineering challenges of India". The other notable event was the release of a book titled "Making of a Satellite Centre: The Genesis of ISRO's UR Rao Satellite Centre" authored by Dr PS Goel, former President, INAE.INAE remains immensely indebted to all those who successfully conducted these calendar events of INAE round the year with utmost dedication and perfection.

INAE celebrated the Engineers' Day last year on September 15, 2021 by organizing an event on "Closing Research-Entrepreneurship Gaps", wherein the Key-note Address was delivered by Dr Anil Kakodkar, Former President, INAE. Five very young and bright entrepreneurs from the engineering fraternity, several of them former INAE Young Entrepreneur Awardees shared their experiences in their journey in entrepreneurship through innovative research in engineering and aired their views for the future. The President INAE moderated this panel discussion session.

Besides organizing the annual events, INAE undertook several initiatives that are meant to help the country make bold strides towards technological self-reliance and long-term societal progress. As is now known, INAE is recognized as a professional peer group for various government and professional bodies because of which, INAE conducts several joint consultations, surveys and reviews and offers actionable recommendations on engineering interventions as important outcome of these activities, studies and events to these agencies for implementation. In this regard, three new joint Consultative Committees were constituted and operationalized with ISRO, DAE and AICTE in the last year. Meetings of these committees have since been held and appreciable progress made.

In pursuance of the ongoing initiative of INAE on development of Regional Transport Aircraft in the country, a delegation from INAE comprising the current and two former Presidents and DG-CSIR met Dr Jitendra Singh, the Hon'ble Minister of State (Independent Charge) for the Ministry of Science and Technology & Earth Sciences on August 25, 2021.The delegation apprised the Honourable Minister about INAE's persistent effort in this direction since 2016 through multiple meetings, seminars, parleys with concerned industry and submission of technical documents. As desired by the Honourable Minister, a summary note on the need and progress of the RTA initiative was forwarded with a firm commitment to offer comprehensive peer assistance from INAE, as and when needed. Subsequently, the President INAE, while attending meetings with the Honourable Minister for Civil Aviation under a separate initiative drew the attention of the Honourable Minister on the same matter a number of times.

INAE conducts several unique activities and programmes with the objective of fostering the growth of engineering and technology in the country. In one such new initiative, INAE has committed to partner and cooperate with Science and Engineering Research Board (SERB) in the following identified directions: SERB-INAE Conclave on Atmanirbhar Technologies - Engineering Secured Future; SERB-INAE Woman Engineers Program; SERB-INAE Outreach Programs for the North-East, Jammu & Kashmir and Ladakh and SERB-INAE Innovation Hackathon. With these novel programmes INAE shall continue to pursue the path of excellence in engineering and promote innovation, enhance gender parity, facilitate growth in inaccessible and remote areas, and also support the initiatives of the Government in many areas such as "Atmanirbhar Bharat".

Digitization of activities is an ongoing mandate of the Academy. The drive to establish and implement INAE Digital Platform to facilitate INAE Fellows submitting nominations online for election to Fellowship, schemes, and awards and also, for improved functioning and coordinating operations of INAE Office have greatly enhanced its utility and effectiveness. INAE Office functioned normally and all online meetings and selection of Fellows and Awardees went as per schedule. At this juncture, I thank the Members of the INAE Digital Platform Committee for strengthening the Academy with this timely intervention. I am also grateful to the Members of all Committees and Fora, especially the ten Sectional Committees who participated and fulfilled their commitment with utmost sincerity and helped the Academy maintain its professional goal and standard in a timely manner.

You may recall that INAE being a Member-Academy of the International Council of Academies of Engineering and Technological Sciences (CAETS) routinely participates in its programmes and convocations of global concern at national and international levels. INAE undertakes joint initiatives with several CAETS Member Academies. In this connection, a series of collaborative activities were organized jointly between INAE and National Academy of Engineering of Korea (NAEK), South Korea since 2017. To continue with the tradition, the fourth Workshop on "What's next in Aerospace Engineering and Materials" was held virtually in June 2021 and dedicated to the celebration of India's 75th Year of Independence (Azadi ka Amrit Mahotsav) which was an outstanding success. In the year 2021, Annual Meetings and Technical Discussion on 'The Future of Energy' was hosted online by Academia Nacional de Ingenieria (ANI), Argentina (Argentina's Academy of Engineering) in September 2021 at Buenos Aires. INAE delegation participated in various Technical Sessions. INAE had nominated Experts for various Technical Sessions during the event. Selected INAE Fellows also participated in the meetings of CAETS Group on Sustainable Development Goals and on Cement Industry and Buildings.

The "Transactions of Indian National Academy of Engineering – International Journal of Engineering and Technology" has increased in its outreach and visibility. The December 2021 issue of the Journal was dedicated to the theme of "Additive Manufacturing".

An important highlight of the last year is the conduct of a large number of topical and interesting webinars conducted by the INAE Local Chapters. I place on record our deepest appreciation for the exemplary contributions by the Local Chapter Committees in undertaking these initiatives and conducting activities and webinars all of which were rich in technical content and had wide participation and generated positive feedback.

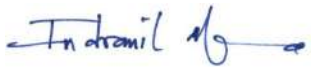
The Abdul Kalam Technology Innovation National Fellowship launched by INAE jointly with DST through SERB and aimed at promoting translational research leading to development of innovative technology, is progressing each year with the receipt of high-quality nominations. Ten eminent nominees were conferred the subject Fellowship during this year and until now, a total of thirty-seven awardees have been selected for conferment of this prestigious Fellowship since its inception. 10 fellows from this select list of awardees have been granted extension of tenure up to five years after due review.

The Frugal Innovation Nurturing Programme (FINP) set up by the Academy to promote grassroot level innovations has recorded a very impressive progress. The MOU between INAE and National Innovation Foundation (NIF) has been extended for another 3 years to support this FINP program to promote the spirit of engineering innovation at the grassroot level to accrue direct benefit to the society.

The Academy is enriched due to the active and significant contributions by the Fellows and Young Associates. Last year, the Gender Parity initiatives taken were truly significant in bringing many eminent women researchers, academicians, scientists engineers and students under the fold of the Academy by way of enhancing participation as Fellows and awardees.

I commend the wisdom of the former Presidents of INAE in taking the technical activities and programmes of the Academy to greater heights of excellence. The contributions of the Fellows and Young Associates are thankfully acknowledged as their response to INAE's call has always been overwhelming. It was delightful to meet many of them and interact in various events conducted in physical or hybrid mode. I look forward to continued and dedicated support in the future years and am sure that the flag of the Academy shall continue to fly high and the activities to foster the growth of engineering and technology shall increase exponentially as time goes by.

Jai Hind!



Indranil Manna
President, INAE

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About the Academy

The Indian National Academy of Engineering (INAE), founded in 1987, comprises India's most distinguished engineers, engineer-scientists and technologists covering the entire spectrum of engineering disciplines. INAE functions as an apex body and promotes the practice of engineering and technology and the related sciences for their application to solving problems of national importance. The Academy provides a forum for futuristic planning for country's development requiring engineering and technological inputs and brings together specialists from related fields as may be necessary for providing comprehensive solutions to the needs of the country.

INAE is the only engineering Academy in India. INAE is a Member of the International Council of Academies of Engineering and Technological Sciences (CAETS). The aims and objects of the Academy are given below.

(a) To promote and advance the practice of engineering and technology and the related sciences and disciplines (hereinafter referred to as 'Engineering') in India and their application to problems of national importance.

(b) To disseminate among its members information on all matters pertaining to 'Engineering' and to encourage, assist and extend knowledge and information connected therewith by publishing such proceedings, journals, memoires, and other publications as may be desirable and hold meetings, lectures, seminars, symposia etc.

(c) To interact, after due and detailed consideration, with professional bodies, engineering and scientific academies etc. already established or as may be established in future in India and abroad.

(d) To promote and safeguard academic and professional interest of persons involved in 'Engineering' (hereinafter referred to as 'Engineer' in India by laying down a code of ethics which shall be an obligation to be signed by all Fellows of the Academy on admission thereto).

(e) To provide an association of eminent 'Engineers' and to present at all academic forums research and developmental activities on 'Engineering' on mutually interactive and cooperative basis, both in India and abroad.

(f) To promote the National Policy on Education of the Government of India as announced from time to time, in all matters of technical education where the Academy is concerned.

(g) To assist the Government of India, the Local Governments, All India Council of Technical Education, and others in analysing, forecasting for the purpose of planning and formulating the policies in respect of education in 'Engineering' and ensuring the appropriate standard thereof.

(h) To offer the Government of India, the Local Governments and others, facilities for conferring with and ascertaining the views of 'Engineers' as regards matters directly or indirectly pertaining to 'Engineering' and to confer with the said Governments and others in cooperation with other fraternal professional bodies in regard to all matters pertaining to 'Engineering'.

(i) To encourage inventions, investigations and research and promote their applications for development of both organised and unorganised sectors of the national economy.

(j) To encourage and promote the pursuit of excellence in the field of 'Engineering'.

(k) To institute and establish Professorships, Fellowships, Studentships, Scholarships, Awards, and other benefactions and to grant Certificates of Competency and Charter whether under any Act of Government of India or otherwise howsoever.

(l) To do all such other acts and things as are incidental or conducive to the attainment of the above objects or any one of them.

INAE Governing Council for the Year 2022

	**President**	: Prof. Indranil Manna, Vice Chancellor, Birla Institute of Technology (BIT), Mesra, Ranchi, Jharkhand [On lien from I.I.T. Kharagpur, W.B.] and Former Director, Indian Institute of Technology Kanpur, U.P.; Former Director, CSIR-Central Glass & Ceramic Research Institute (CGCRI), Kolkata.
	**Immediate Past President**	: Dr. Sanak Mishra, Member of the Governing Board of the Steel Research & Technology Mission of India. Formerly Managing Director, Rourkela Steel Plant and Director, Steel Authority of India Ltd. (SAIL); Vice-President, ArcelorMittal and CEO India Projects; Secretary General, Indian Steel Association; President, Indian Institute of Metals.
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	Chief Editor of Publications and GC Member affiliated to Engg Section-III	: Prof. Amit Agrawal, Professor, Department of Mechanical Engineering, Indian Institute of Technology Bombay, Mumbai.

Members

	Engg Section-I	: Ms Alpa Sheth, Managing Director, VMS Consultants Pvt Ltd, Mumbai.

Engg Section-II : Prof. Subhasis Chaudhuri, Director, Indian Institute of Technology Bombay, Mumbai.

Engg Section-IV : Mr. DP Misra, Director, Development Consultants Pvt Ltd & Adviser, Jindal Steel and Power Ltd., Mumbai.

Engg Section-V : Dr. Archana Sharma, Outstanding Scientist, Director, Beam Technology Development Group, BARC, Mumbai.

Engg Section-VI : Prof. Anurag Kumar, Former Director, Indian Institute of Science, Bangalore.

Engg Section-VII : Dr. Tessy Thomas, Distinguished Scientist & Director-General, Aeronautical System, Defence Research and Development Organisation (DRDO), Bangalore.

Engg Section-VIII : Dr. Debashish Bhattacharjee, Vice President, Technology & New Materials Business, Tata Steel, Kolkata.

Engg Section-IX : Prof. Rangan Banerjee, Director, Indian Institute of Technology Delhi.

Engg Section-X : Prof. Kripa Shanker, Visiting Professor, Mechanical Engineering Department, Indian Institute of Technology (BHU) Varanasi.

Representatives of various Organisations

Department of Science & Technology (DST), Ministry of Science & Technology : Prof. Sushmita Mitra, Professor HAG, Machine Intelligence Unit, Indian Statistical Institute, Kolkata.

Ministry of Education (Erstwhile MHRD) : Prof. Bhaskar Ramamurthi, Former Director, IIT Madras and Professor, Dept of Electrical Engg, IIT Madras.

Department of Space (DOS) : Dr. VR Lalithambika, Former Distinguished Scientist and Director, Directorate of Human Space Programme, ISRO, Bangalore.

All India Council for Technical Education (AICTE) : Dr. Rajeev Shorey, Chief Executive Officer (CEO), University of Queensland – IIT Delhi Academy of Research (UQIDAR), IIT Delhi.

Indian National Science Academy (INSA) : Prof. V Ramgopal Rao, Former Director, Indian Institute of Technology Delhi, New Delhi.

Defence Research & Development Organisation (DRDO) : Mr. BHVS Narayana Murthy, Distinguished Scientist and Director General Missiles & Strategic Systems, Office of the DGMSS, Hyderabad.

Department of Atomic Energy (DAE) : Mr. RN Jayaraj, Formerly Chairman & Chief Executive, Nuclear Fuel Complex, Department of Atomic Energy, Hyderabad.

	Confederation of Indian Industry (CII)	:	Dr. Ashish Mohan, Head-Technology, Innovation, IPR, and Design, Gurgaon.
	Federation of Indian Chambers of Commerce & Industry (FICCI)	:	Mr. Shyam Bang, Chairman, FICCI Taskforce on Manufacturing Excellence, FICCI, New Delhi.
	The National Association of Software and Services Companies (NASSCOM)	:	Awaited

INAE Committees

Sectional Committees

The composition of the ten Sectional Committees is given below.

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Prof. MC Deo
Prof. Subhasish Dey
Prof. R Gettu
Dr. SK Gupta
Mr. Alok Bhowmick
Prof. PP Mujumdar
Prof. Ligy Philip
Dr. VN Sharda
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Prof. PJ Narayanan
Dr. Raghu Krishnapuram
Mr. Vinay V Kulkarni
Prof. Ujjwal Maulik
Prof. Sushmita Mitra
Prof J Mukhopadhyay
Prof. Hema A Murthy
Prof. Niloy Ganguly
Mr. Rajesh Gopinathan
Prof. S Sudarshan

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Dr. C Ranganayakulu
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Mr. Atul Sobti
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Dr. Biswajit Basu
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Prof. NK Mukhopadhyay
Prof. DC Panigrahi
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Dr. Pradip

Prof. AB Pandit

Prof. Sivaji Chakravorti

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Dr V Narayanan

Shri Sankaran M.

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Prof Sanjay Mittal

Prof RI Sujith

Dr AR Upadhya

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Prof. Suman Chakraborty

Prof. Sunando Dasgupta

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Prof. NK Mukhopadhyay

Dr. Soumitro Tarafder

Dr. S Venugopal

Invitees

Dr. R Balamuralikrishnan

Prof. NB Ballal

Dr. Pravin P Deshpande

Dr. S Jaikishan

Dr. V Jeyaraj

Dr. P Parameswaran

Dr. Vasant Shinde

Prof. Sharada Srinivasan

Prof. Vibha Tripathi

INAE Travel Grant (TG) Scheme Committee

Chairman

Prof. AB Pandit

Members

Prof. Santanu Bandyopadhyay
Prof. Suman Chakraborty
Prof. Sirshendu De
Prof. G Jagadeesh
Prof. NK Mukhopadhyay
Prof. Sushmita Mitra
Prof. CVR Murty
Prof. Hema A Murthy
Prof. Ligy Philip
Prof. Krishna Moorthy Sivalingam

AICTE-INAE Distinguished Visiting Professorship (DVP) Scheme Committee

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Prof. Purnendu Ghosh

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Dr. BK Panigrahi
Dr. Pradip
Prof. Kripa Shanker
Dr. Rajiv Kumar Tayal
Prof. Manoj K Tiwari
Rep., AICTE
Rep – CII

AICTE-INAE Travel Grant (TG) Scheme Committee

INAE Travel Grant (TG) Scheme Committee

Chairman

Prof. Purnendu Ghosh

Convener

Prof. BS Murty

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Prof. K Bhanu Sankara Rao
Prof. Santanu Bandyopadhyay
Prof. PK Das
Prof. Sirshendu De
Prof. G Jagadeesh
Prof. Sushmita Mitra
Prof. NK Mukhopadhyay
Prof. CVR Murty
Prof. Hema A Murthy
Prof. Ligy Philip
Prof. Satyam Suwas
Prof. SV Kulkarni
Prof. Nandita Dasgupta
Rep - AICTE
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Forum on Energy

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Dr. Ajay Mathur

Vice-Chairman

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Members

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Prof. Pradip Dutta
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Prof. Chandra Venkatraman

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Dr. Sanak Mishra

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Prof. Santosh Kapuria

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Prof. N Raghavan

Mr. K Senou

Dr. Mangu Singh

Prof. PK Sikdar

Prof. Mahesh C Tandon

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Deputy Executive Director

DR. GEETANJALI SAWHNEY
Senior Research Officer

MS. PRATIGYA LAUR
Research Officer

MR. VIRENDER KUMAR
Senior Manager (A&E)

DR. DEBJANI BHATTACHARYA
Research Officer

MS. SHELIKA ARORA
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MR. BHUWAN ADHLAKHA
Manager (F&A)

MR. RAMACHANDRAN EP
Manager (A&E)

MR. SHEETAL SHARMA
Assistant Systems Engineer

MR. RAHUL GARG
Assistant Systems Engineer

MS. HEMA GUPTA
Senior Assistant Grade-I

MR. RS CHAUHAN
Senior Assistant Grade-III

MR. BALWANT SINGH
Assistant Grade-I

MR. GOURAV D KANDALGAONKAR
Assistant Grade-II

MR. SATISH KUMAR VERMA
Multi-Tasking Staff

Digitization of INAE activities

The INAE Digital Centre was formally inaugurated by Prof Ashutosh Sharma, FNAE, the then Secretary, DST on February 15, 2019, at the 9th Floor of SPAZE IT Park, Tower A, Gurgaon. The first INAE Digital Platform Committee was formed under the Chairmanship of Dr. Pradip, the then Vice-President, INAE with Mr. K Ananth Krishnan, Dr. Manish Gupta, Mr. Vinay V Kulkarni, Prof. Hema A Murthy, Dr. Sriram K Rajamani and Dr. K Ramamritham as members. The Committee played an important role in identifying the requirement for digital transformation of INAE activities. Several modules were identified and an interactive INAE website was conceived which can serve as the gateway to the digital modules.

Following proper bidding process, the vendor for the development was awarded the project with INAE Governing Council's approval. A Review Committee of INAE Digital Platform was formed under the Chairmanship of Mr. K Ananth Krishnan to review progress of digitization and plan way forward. Under the expert guidance of the said Committee, twenty-two modules were planned based on the existing schemes and awards dealt by the Academy revamping online submission of nomination for INAE Schemes, INAE Awards, AICTE-INAE Schemes and SERB Schemes.

INAE website was made bilingual and new features were added as: Wider Slide Show of photos; Improved Site Search; Quick Links; 'What's New'- section including Recent/Forthcoming activities and INAE Activities Spotlight; Improved Sitemap (for better website navigation); Online application for INAE schemes; Downloadable INAE Publications and Social media Integration.

INAE has also developed a registration site to facilitate registration process for all INAE online and offline activities. The registration facility has been extended to INAE local chapters. Each local chapter has an individual page where the corresponding registration page has been linked.

The Digital Platform Committee was reconstituted under Chairmanship of Mr. K Ananth Krishnan with Dr. Manish Gupta, Mr. Vinay V Kulkarni, Prof. Hema A Murthy, Dr. Sriram K Rajamani and Prof Sukumar Nandi as members and Dr. Pradip and Prof Purnendu Ghosh as permanent invitees in September 2020.

Usage of INAE Digital Platform expanded appreciably since its inception. Active participation of INAE Fellows, Young Associates and other stakeholders has led to modification of several modules thus enhancing functionality of the platform. The server had to be upgraded in 2021-22 as a step towards capacity building for further expansion. The platform in its present form has the following active modules:

- **Facilities for INAE Fellows and Young Associates**
  - Secure Login for INAE Fellows, Staff and Young Associates
  - INAE Fellow personal Profile page with Dashboard
  - Access to Transactions of INAE
  - Request for Webinar
  - Online Travel Request for INAE Fellows
  - Consent option for participation in INAE Mentoring Schemes for engineering students and engineering teachers
  - Consent option for inclusion of Fellow/Young Associate profiles in INAE Expert Pool
  - Online Review of nominations by INAE Fellows for all active modules
  - Online Peer Review of Fellow Nominations

- **Online facilities provided in INAE Website (open domain) for application**
  - INAE Young Engineer Award
  - Mentoring of Engineering Students by INAE Fellows and INAE Young Associates
  - Mentoring of Engineering Teachers by INAE Fellows and INAE Young Associates
  - INAE Travel Grant
  - Innovative Student Projects Award (yet to be activated)
  - AICTE-INAE Travel Grant Scheme
  - AICTE-INAE Distinguished Visiting Professorship Scheme
  - Abdul Kalam Technology Innovation National Fellowship (yet to be activated)

- **Online facilities for Nominations by INAE Fellows**
  - Nomination for INAE Fellowship (includes both Indian and Foreign Fellowship)
  - Mentoring of Engineering Teachers by INAE Fellows and INAE Young Associates
  - Mentoring of Engineering Students by INAE Fellows and INAE Young Associates
  - Lifetime Contribution Award in Engineering
  - Professor SN Mitra Memorial Award
  - Professor Jai Krishna Memorial Award
  - INAE Outstanding Teachers Award
  - INAE Woman Engineer of the Year Award
  - INAE Young Engineer Award
  - INAE Young Innovator and Entrepreneur Award (yet to be activated)
  - INAE Chair Professorship
  - INAE Distinguished Professor/Technologist

Active modules for receiving nominations: Eleven modules have been made live in 2021-22 to receive online nominations and applications as per details given below:

1. Nomination for INAE Fellowship
2. Lifetime Contribution Award in Engineering
3. Professor Jai Krishna Memorial Award
4. Professor SN Mitra Memorial Award
5. INAE Outstanding Teachers Award
6. INAE Woman Engineer of the Year Award
7. INAE Young Engineer Award
8. Mentoring of Engineering Teachers by INAE Fellows
9. Mentoring of Engineering Students by INAE Fellows
10. AICTE-INAE Travel Grant Scheme
11. AICTE-INAE Distinguished Visiting Professorship scheme

Nominations and applications were received in 2021 and were also received in 2022 through Digital Platform for the above modules. Since the platform is relatively new, hybrid mode for receiving nominations was adopted. Provisions were made in the platform so that nominations received both through email and through post could be collated and uploaded for online review by corresponding Review Committees.

The online update facility for Fellow nominations received through Digital Platform was also developed and successfully implemented from 2021. For 45 carried forward nominations received through Digital Platform, 31 updates were received online during 2021. During the year 2022, 62 online updates were received against a total of 102 carried forward application received through Digital Platform.

Enabling this facility helped receive more than 250 reviews on 230 nominations. The Sectional Committee reviews were successfully organized online wherein each Sectional Committee member could review the nominations online before respective meetings and put forward their comments on nominees to Convener using the Digital Platform.

Digital Platform was also used this year to review nominations of INAE prestigious awards namely Lifetime Contribution Award in Engineering, Professor Jai Krishna Memorial Award, Professor SN Mitra Memorial Award, INAE Outstanding Teachers Award and INAE Woman Engineer of the Year Award. Effort to introduce new modules and features on the Digital platform are ongoing

INAE Webinar Series
Launch of INAE Webinar Series

INAE launched a Webinar Series during 2020 as an initiative of INAE Digital Platform Committee. 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.

Currently, INAE along with its Local Chapters conduct more than one webinar, a month. INAE has hosted several flagship events such as INAE Youth Conclave, Engineers Conclave, INAE Foundation Day Celebrations, Technical Presentations by INAE Fellows and INAE Young Associates during INAE Annual Convention on this platform for the enhanced visibility by Fellowship and other professionals of engineering fraternity. The recordings of the Webinars have also been uploaded in INAE Youtube account, and an access has been provided on INAE website.

INAE Digital Content and Webinars Committee was reconstituted under the Chairmanship of Mr K Ananth Krishnan and Member representatives from each Engineering Section to help create digital content, facilitate webinars and plan additional activities with a view to reach out to the larger community of engineers.

The links of the recordings of the webinars are available on INAE website at the link: https://www.inae.in/publications/inae-webinar-series/.

(a) Details of the webinars conducted with support from INAE Head Quarters and or/organized along with Local Chapters are enlisted below:

Sl No	Date	Title of Lecture/Workshop/Seminar/Conference	Organised by INAE Hqrs. / INAE Local Chapter
1	Webinar-29: March 01, 2022	Development of S&T in post independent India by **Dr. Shekhar C. Mande**, FNA; Secretary, DSIR & Director General, CSIR.	Kolkata
2	Webinar-28: March 01, 2022	The Brave New World of Science Today is but the World of J. C. Bose: Coming Full Circle by **Prof. Ashutosh Sharma**, FNAE, Institute Chair Professor, Department of Chemical Engineering, IIT Kanpur & Former Secretary to the Government of India, Department of Science and Technology.	Kolkata

3	Webinar-27: February 19, 2022	An R&D Road Map for Indian eMobility – 2022 to 2030 by **Mr. Karthick Athmanathan**, Senior VP at Ashok Leyland, Professor of Practice at IIT Madras.	Chennai
4	Webinar-26: February 19, 2022	Why is "Urban Air Pollution" a Regional Misnomer: The India narrative by **Prof. Chandra Venkataraman**, FNAE, Interdisciplinary Programme in Climate Studies & Department of Chemical Engineering, IIT Bombay.	Mumbai
5	Webinar-25: January 17, 2022	Materials for Defence: Challenges and Opportunities by **Dr. Samir V Kamat**, Distinguished Scientist and Director General (Naval Systems & Materials), Ministry of Defence, DRDO.	Hyderabad
6	Webinar-24: December 08, 2021	Role of nuclear energy in decarbonization of Indian energy sector by **Distinguished Speakers**.	INAE Hqrs.
7	Webinar-23: October 22, 2021	Decarbonisation of Cement, Steel & Power Sector by **Mr. Ulhas Parlikar**, Global Consultant (Strategies for Waste Management, Circular Economy, Policy Advocacy, AFRs & Co-processing) & Retd Director, Geocycle Business & Dy Head, Geocycle India.	Mumbai
8	Webinar-22: September 15, 2021	My Personal Journey with IEEE by **Ms. Susan Kathy Land**, IEEE President and CEO.	Kolkata
9	Webinar-21: September 15, 2021	Closing Research-Entrepreneurship Gaps by **Dr Anil Kakodkar**, Former President INAE, AICTE Distinguished Chair Professor, Formerly Chairman, AEC & Secretary, GoI, DAE.	INAE Hqrs.
10	Webinar-20: August 9, 2021	Future Mobility: E Mobility by **Distinguished Speakers**.	Mumbai
11	Webinar-19: July 31, 2021	Creating Foundational Partnerships: Building on the strength of US-India collaboration towards a roadmap for the future by **Dr. Sethuraman Panchanathan**, Director, National Science Foundation, USA.	INAE Hqrs.
12	Webinar-18: June 9, 2021	Production and Utilization of Green Hydrogen by **Distinguished Speakers**.	Mumbai
13	Webinar-17: Apr 23, 2021	Building a Space Telescope by **Prof. Varun Bhalerao**, Department of Physics, IIT Bombay.	Mumbai
14	Webinar-16: Apr 22, 2021	Connecting Academic R&D with Product Innovation: A few case studies and a way forward by **Prof. V Ramgopal Rao**, Director, IIT Delhi.	Kolkata
15	Webinar-15: Apr 20, 2021	Special lectures on the 35th Foundation Day of INAE and inauguration of the India's "Azadi Ka Amrit Mahotsav" celebration by INAE by **Distinguished Speakers**.	INAE Hqrs.

(b) Details of webinars conducted by the Local Chapters are as given below:

Sl No.	Date	Title of Lecture/Workshop/Seminar/Conference	INAE Local Chapter
1	Webinar-41 March 30, 2022	10th SAMVAAD Lecture – an IIT Dharwad-INAE Bangalore Chapter Lecture Series - IIT System and Excellence-Issues and Concerns by Professor SS Murthy, Adjunct Professor, NIAS, Bangalore and IIT Ropar.	Bangalore
2	Webinar -40 March 8, 2022	Fifth Lecture of the Distinguished Lecture Series - Achieving Sustainability and Net Zero Mandate Through Adoption of Hydrogen Economy, CO_2 Refineries, & Biomass Conversion by Professor G. D. Yadav, Emeritus Professor of Eminence and Former Vice Chancellor, Institute of Chemical Technology, Mumbai.	Bhubaneswar
3	Webinar-39 March 7, 2022	Fourth Lecture of the Distinguished Lecture Series - India's self-sufficiency in materials for 21st century by Dr. Debashish Bhattacharjee, Vice President, Technology & New Materials Business, Tata Steel.	Bhubaneswar
4	Webinar-38 February 23, 2022	9th SAMVAAD Lecture – an IIT Dharwad-INAE Bangalore Chapter Lecture Series - National Biofuel Policy & Initiatives-evolving ecosystem by Shri Y. B. Ramakrishna, Member-Working Group on Bio Fuels, MoP&NG.	Bangalore
5	Webinar-37 February 7, 2022	Third Lecture of the Distinguished Lecture Series - Revenge of Silicon-tracing the trends in computing and communication and how the machines mimic man by Prof N Balakrishnan, Indian aerospace and computer scientist.	Bhubaneswar
6	Webinar-36 January 28, 2022	8th SAMVAAD Lecture – an IIT Dharwad-INAE Bangalore Chapter Lecture Series - Floods in a Changing Climate: An Emerging Engineering Challenge by Prof. P. P Mujumdar, Fellow of INAE, Chairman, ICWaR; Professor, Department of Civil Engineering, Indian Institute of Science, Bangalore.	Bangalore
7	Webinar-35: January 10, 2022	Workshop "Agricultural Technologies-Present and Future" by Distinguished Speakers.	Bangalore
8	Webinar-34: January 7, 2022	Second Lecture of the Distinguished Lecture Series - Democratized Diagnostic Technologies towards Affordable Healthcare for the Underserved by Prof. Suman Chakraborty, Institute Chair Professor & Sir J C Bose National Fellow, Professor, Department of Mechanical Engineering, IIT Kharagpur.	Bhubaneswar
9	Webinar-33: December 9, 2021	Role of Artificial Intelligence in Missile Applications by Dr. BHVS Narayana Murthy, FNAE, Distinguished Scientist and Director General (MSS), Ministry of Defence, DRDO.	Hyderabad
10	Webinar-32: December 7, 2021	Inaugural Lecture of the Distinguished Lecture series - Science-Engineering-Technology: Synergy for Sustainable Growth by Prof. Indranil Manna, President INAE and Vice Chancellor, BIT, Mesra.	Bhubaneswar
11	Webinar -31 November 24, 2021	7th SAMVAAD Lecture – an IIT Dharwad-INAE Bangalore Chapter Lecture Series - Empowering Students through NEP by Prof. Anil D. Sahasrabudhe, FNAE, Chairman, AICTE.	Bangalore

Sl No.	Date	Title of Lecture/Workshop/Seminar/Conference	INAE Local Chapter
12	Webinar-30: October 28, 2021	INAE-BC Frontiers of Engineering webinar - Sensor Scaling for Intelligent Heterogeneous Systems by Prof. Navakanta Bhat, Professor, IISc Bangalore.	Bangalore
13	Webinar-29: October 28, 2021	"Livin' in a Material World: Materials Driving the Data Storage Revolution" by Dr. Siva Sivaram, President, Technology and Strategy, Western Digital, USA.	Delhi
14	Webinar-28: October 27, 2021	6th SAMVAAD Lecture - an IIT Dharwad-INAE Bangalore Chapter Lecture Series - AATMANIRBHAR BHARAT IN AVIATION– From Light Combat Aircraft to Regional Transport Aircraft Development" by Dr Kota Harinarayana, FNAE, Former Director and Chief Designer of LCA.	Bangalore
15	Webinar-27: September 30, 2021	5th SAMVAAD Lecture - an IIT Dharwad-INAE Bangalore Chapter Lecture Series - Decarbonisation and Hydrogen Economy for India by Dr Anuradda Ganesh, Director and Chief Technical Advisor, Cummins India.	Bangalore
16	Webinar-26: September 15, 2021	Lecture on "Achievements in civil structures and engineering in India" by Prof. Ananth Ramaswamy, Chair, Department of Civil Engineering, IISc, Bangalore.	Bangalore
17	Webinar-26: September 15, 2021	Lecture on "India becoming a technology powerhouse" by Dr V K Aatre, Chairman, INAE Bangalore Chapter, and Former SA to RM, DRDO	Bangalore
18	Webinar-25: August 28, 2021	5th Foundation Day and 4th SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series - India's energy security in a carbon constrained world by Dr Anil Kakodkar, Padma Vibhushan and Former Chairman, Atomic Energy Commission.	Bangalore
19	Webinar-24: August 19, 2021	Benefits and challenges in the next decade of semiconductor innovation by Dr. Randhir Thakur, Senior Vice President and President of Intel Foundry Services, Intel, USA.	Delhi
20	Webinar-23: July 31, 2021	INAE-BC Frontiers of Engg Webinar Series - Advent of AI in medical Devices by Dr. Gopal Avinash, Global Leader of Data Science, GE Healthcare's Edison AI Services.	Bangalore
21	Webinar-22: July 29, 2021	Energy Efficient IoT Devices – the Quest for Longer Battery Life by Mr. N Venkatesh, Sr. Director, Silicon Labs, Hyderabad.	Delhi
22	Webinar-21: July 28, 2021	3rd SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series - Electric Vehicles – Current Trends and Future Strategies by Dr Kaushik Rajashekara, FIEE and Distinguished Professor, University of Houston.	Bangalore
23	Webinar-20: July 20, 2021	Annual Memorial Professor Roddam Narasimha lecture on "Contributions of Prof. Roddam Narasimha in the area of re-laminarization Research" by Prof. K R Sreenivasan, New York University.	Bangalore
24	Webinar-19: June 30, 2021	SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series - Mastering Rocket Science: Experiences and Excitements by Dr BN Suresh, former President, INAE and Chancellor, IIST, Thirvananthapuram.	Bangalore

Sl No.	Date	Title of Lecture/Workshop/Seminar/Conference	INAE Local Chapter
25	Webinar-18: June 25, 2021	Ethics on Higher Education by Distinguished Speakers.	Bangalore
26	Webinar-17: June 24, 2021	INAE-BC Frontiers of Engg Webinar Series - An Overview of Smart Manufacturing and its Implications for Innovation and Growth by Prof. Amaresh Chakrabarti, Centre for Product Design and Manufacturing, IISc Bangalore.	Bangalore
27	Webinar-16: April 29, 2021	INAE-BC Frontiers of Engg Webinar Series - Harnessing of Solar Energy Through Photothermal Conversion by Dr. Harish Barshilia, CSIR-National Aerospace Laboratories, Bangalore.	Bangalore
28	Webinar-15: April 27, 2021	Data Analytics, Machine Learning and Deep Learning by Prof. Ganapati Panda, FNAE and a member of Bhubaneswar Chapter.	Bhubaneswar
29	Webinar-14: April 20, 2021	Building New Institution Challenges and Opportunities" and "Evolving a business model for commercialization of Grassroots Innovation by Distinguished Speakers.	Bangalore
30	Webinar-13: April 17, 2021	Smart Cities in Karnataka – Experiences and the road ahead by Distinguished Speakers.	Bangalore
31	Webinar-12: April 8, 2021	Towards City-Scale Low-Power Wireless Internet by Dr. Swarun Kumar, Assistant Professor, Carnegie Mellon University (CMU), USA.	Delhi

INAE Expert Pool: INAE Expert Pool was initiated in 2015 with the objective of having a searchable database of INAE Experts. This would facilitate Heads of Industry, Academia, R&D Organizations, private trusts, government agencies, start-ups and entrepreneurs to connect with INAE Fellows and utilize their expertise for consultancy assignments. To keep Expert Pool profiles of INAE Fellows and Young Associates updated, the web application of INAE Expert Pool has been linked with INAE Profile page of each Fellow and Young Associate, so that real time updates will be visible in the Expert Pool pages. The application has a searchable database of INAE Fellows and INAE Young Associates who have consented to be a part of the Expert Pool. To get the consent, the Fellow/ Young Associate profile page has been provided with a checkbox option to enable his/her profile to appear in public domain (Expert Pool) for contact.

INAE on Facebook, Twitter, LinkedIn and YouTube

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 @inaehq1

(c) LinkedIn- link https://www.linkedin.com/in/inae-inae-20258b178/

(d) Instagram ID: https://www.instagram.com/inaehq/

(e) YouTube- link https://www.youtube.com/channel/UCXOkjYeIRPADua-dny4W1Xg

All INAE Fellows are requested to visit and follow the above social media sites so as to increase the visibility of INAE in Social media.

New Initiatives during the Year

INAE, in addition to many of its well-defined activities, has been giving a major thrust to identify the issues of National importance where engineering interventions can provide the appropriate solutions and also to get associated with some of the vital policy matters. INAE has been making efforts to identify such problems of National importance in consultation with many of the Government Departments and is looking at the policy matters which are referred to the Academy by the concerned agencies for generating the right inputs. With this objective in mind, INAE has undertaken a number of new initiatives in terms of commencing new programmes and conduct of unique events during this year, which have enhanced the outreach and visibility of the Academy both in India and abroad. A brief summary of these novel initiatives is highlighted below.

SERB-INAE Collaborative Initiative in Engineering

Indian National Academy of Engineering (INAE) and Science and Engineering Research Board (SERB), Department of Science and Technology (DST) launched a new initiative to recognize and promote translational research in public funded institutions in India in the form of Abdul Kalam Technology Innovation National Fellowship during the year 2017. Within a few years, Kalam Fellowship has attained such a great level of eminence and interest in the engineering community that it is now regarded as one of the benchmarks of achievement in engineering domain and as prestigious as the JC Bose Fellowship of DST for various scientific disciplines. While cooperation between DST and INAE will continue through the DST-INAE Consultative Committee, it was considered important to institute a similar platform between INAE and SERB to promote and serve the interest and aspirations of the country in the area of Engineering and Technology, by adopting a selected few new initiatives that may strengthen the resolution of the Government of India drives like Atmanirbhar Bharat, etc., as mentioned below:

Therefore, INAE has committed to partner and cooperate with Science and Engineering Research Board (SERB) in the following identified verticals:

(i) SERB-INAE Conclaves on Atmanirbhar Technologies -Engineering Secured Future

(ii) SERB-INAE Woman Engineers Program

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

(iv) SERB-INAE Innovation Hackathon

A Letter of Intent was signed by Prof Sandeep Verma, Secretary, SERB and Prof Indranil Manna, President, INAE on November 9, 2021 to this effect. A detailed proposal to undertake the above initiative was submitted to SERB on March 22, 2022. The finalization of modalities and budget for above-mentioned Programs/ events is in progress. It was also decided to constitute an INAE -SERB Consultative Committee.

New Joint Consultative Committees

INAE currently has several Consultative Committees with DST, DRDO, CSIR and Office of PSA which meet periodically to facilitate interaction and identification of topics on thrust areas of engineering for conduct of technical activities and programmes. This year, several new joint Consultative Committees have been constituted as given below.

ISRO-INAE Consultative Committee

The ISRO- INAE Consultative Committee had been recently constituted to meet periodically and discuss the activities undertaken by INAE so as to align them with the thrust areas of national importance. The first meeting of the Committee was held on July 1, 2021 which was attended by the following members:

- Dr K Sivan, Chairman, ISRO/Secretary DOS : Co-Chair
- Prof Indranil Manna, President, INAE : Co-Chair
- Shri AS Kiran Kumar, Former Chairman, ISRO, Bangalore
- Shri S Somanath, Director, VSSC, Thiruvananthapuram
- Dr VR Lalithambika, DHSP, ISRO HQ, Bangalore
- Dr V Narayanan, LPSC, Thiruvananthapuram
- Dr BN Suresh, Past President, INAE & Chancellor, IIST, Bangalore
- Prof Sanjay Mittal, IIT Kanpur
- Prof RI Sujith, IIT Madras
- Dr AR Upadhya, ADA, Bangalore
- Mr Arun Ramchandani, L&T

Various joint initiatives between ISRO and INAE were discussed wherein both organizations can work together to contribute in terms of the technologies that are already available such as healthcare sector, sensor technologies, Material research for aerospace, Additive Manufacturing etc.

The composition of the ISRO-INAE Consultative Committee was revised subsequently as under.

Co-Chairs
Shri S Somanath
Prof Indranil Manna

Members from ISRO
Shri AS Kiran Kumar
Dr. Sam Dayala Dev
Dr V Narayanan
Shri Sankaran M.
Dr. Unnikrishnan Nair

Members from INAE
Dr BN Suresh
Prof Sanjay Mittal
Prof RI Sujith
Dr AR Upadhya
Mr Arun Ramchandani
Member-Secretary – Deputy Executive Director /
Executive Director, INAE

DAE-INAE Consultative Committee

It was proposed to constitute a DAE-INAE Consultative Committee and the same was constituted in January 2022. The Chairman, DAE and the President, INAE are the Co-Chairs of the Committee and a few senior officials from DAE and eminent Fellows from INAE are the members of this Committee. The Composition of the Committee is as follows:

Co-Chairs:

- Mr KN Vyas, Chairman, Atomic Energy Commission and Secretary, Department of Atomic Energy, GoI
- Prof Indranil Manna, President, INAE

Members from DAE:

1. Dr AK Mohanty, Director, Bhabha Atomic Research Centre, Mumbai
2. Mr RN Jayaraj, Formerly Chairman & Chief Executive, Nuclear Fuel Complex, Department of Atomic Energy, Hyderabad and DAE Representative to INAE Governing Council
3. Shri Vivek Bhasin, Director, Nuclear Fuels Group (NFG), RLG, Bhabha Atomic Research Centre (BARC), Mumbai
4. Dr (Smt) SB Roy, Ex-Associate Director, Chemical Engineering Group, Bhabha Atomic Research Centre, Ex-Raja Ramanna Fellow
5. Shri Ranajit Kumar, Head, Nuclear Controls & Planning Wing, Department of Atomic Energy, Mumbai

Members from INAE:

1. Prof AB Pandit, Vice-President, INAE & Vice-Chancellor, ICT, Mumbai
2. Mr. SC Chetal, FNAE & Formerly Distinguished Scientist and Director, IGCAR, Kalpakkam
3. Prof Pradip K. Tewari, FNAE & Head of Department of Chemical Engineering, IIT Jodhpur, Former Distinguished Scientist (DS) & Associate Director ChEG, BARC and Former Professor, HBNI, Mumbai
4. Dr GK Dey, Head, Materials Science Division, BARC, Mumbai
5. Dr. LM Gantayet, Former Distinguished Scientist and Director, Beam Technology Development Group, BARC, Mumbai

Member Secretary: Executive Director (ED)/Deputy ED, INAE

AICTE-INAE Consultative Committee

AICTE and INAE had been actively engaged since long to enhance the quality of engineering education in the country through various joint schemes. Hence, AICTE-INAE Consultative Committee was constituted with the Chairman, AICTE and President, INAE as Co-Chairs and a few senior officials from AICTE and eminent Fellows from INAE as the members of this Committee. The Committee had its first meeting on January 25, 2022 wherein the scope of joint activities was discussed between the two organizations. The Composition of the Committee is as follows:

Co-Chairs:

- Prof Anil D Sahasrabudhe, Chairman, AICTE
- Prof Indranil Manna, President, INAE

Members from AICTE:

1. Prof MP Poonia, Vice Chairman, AICTE
2. Prof. Rajive Kumar, Member Secretary, AICTE
3. Dr Ramesh Unnikrishnan, Advisor, AICTE

Members from INAE:

1. Prof Purnendu Ghosh, Vice-President, INAE & Executive Director, Birla Institute of Scientific Research, Jaipur
2. Prof BS Murty, FNAE & Director, IIT Hyderabad
3. Prof. Manoj Kumar Tiwari, FNAE & Director, National Institute of Industrial Engineering (NITIE), Mumbai
4. Prof. Sushmita Mitra, FNAE & Professor, ISI Kolkata
5. Prof. S Narayanan, FNAE & Professor Emeritus (Adjunct), IIIT (Design and Manufacturing (IIITDM)), Chennai and Formerly Professor and Dean (AR), IIT Madras.

Further details are given in the section on "Reaching out to Policy Makers: Interaction with Government Agencies".

Online Expo of Innovations by Start-ups in India

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

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

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

The highlights of the said event are as under:

a. The event will be an "Online Exposition of Innovations by Start-ups in India" wherein any entrepreneur/ team willing to showcase their ideas /projects has to present the innovation in video format.

b. Themes of the Online Expo are:
   - Clean Mobility
   - Waste to Wealth
   - Agriculture Technology
   - Skilling and Livelihood
   - Digital Healthcare Technologies

   c. Prizes for the winners of each focal sector of the exposition would be given:
   - Rs.50,000/- for winners
   - Rs.25,000/- for runners up

d. The last date of receiving applications was 7th March 2022 and shortlisting of videos was 21st March 2022.

This is the first event of its kind planned by INAE.

Implementation of Gender Parity Policy in INAE

INAE has been discussing the Gender Parity issue for the past several years and in this direction, a Gender Parity Advisory Committee was constituted under the Chairmanship of Dr. BN Suresh, former President, INAE with Dr. Saswasti B Roy, Prof Sushmita Mitra, Dr. VR Lalithambika, Prof. Ligy Philip, Ms Alpa Seth, Prof K Chattopadhyay, and Prof Prem Krishna as Members to deliberate and suggest proactive measures to achieve acceptable level of gender parity in INAE. Dr BN Suresh had prepared a Base Paper on the issue of Gender Parity in INAE which is summarized as follows.

Gender parity subject was being discussed in many forums in India for a long time. INAE has only 28 women Fellows out of 871 Fellows in India, which is a meagre 3% of the entire Fellowship. Similarly, the representation of women in Young Associates is also limited. Although INAE has been pursuing a proactive policy to induct women into Fellowship for the last few years, there is limited success. It is therefore felt essential that there is a need to deliberate in detail and generate suitable recommendations to improve the situation in all these forums of INAE. There is also a need for innovative and out-of-box thinking to drive gender parity. Perforce, the implementation aspects also possibly demand certain structural changes to improve the nomination and selection processes and create an enabling environment. The recommendations so made should also be actionable and implementable.

The Base Paper on the subject prepared by Dr. BN Suresh was deliberated in the first meeting of said Committee held on 6th May 2021 wherein a number of valuable suggestions/comments emerged. These culminated in the form of Draft Recommendations on Gender Parity of INAE. The Draft Recommendations were circulated to the members to seek inputs before further deliberations in the next meeting of the said Committee held on May 22, 2021, so as to consolidate the same into actionable and implementable recommendations on Gender Parity in INAE. Productive meetings were held, and clear-cut recommendations were crystallized. The final Recommendations were put up for further discussion and approved by Governing Council during its meeting held in June 2021 for implementation from the year 2021 itself.

Accordingly, the following two Search Committee (Group-1: Mechanical Group and Group 2: Electrical Group) were constituted under the Chairpersonships of Dr. (Mrs.) Saswati B Roy and Prof. Nandita Dasgupta respectively, with a major role to bring gender parity in INAE by scouting and nominating deserving women candidates for Election to the Fellowship/Awards of INAE before the last date of nominations and also to associate women engineers, startups and engineering institutions with activities of INAE.

Search Committee (Group-1: Mechanical Group)

Dr. (Mrs.) Saswati B Roy (Chairperson)
Prof. Ligy Philip
Dr. Janhavi Sanjay Raut
Dr. VR Lalithambika
Mr. Alok Bhowmick
Prof. Sameer Khandekar
Prof. R I Sujith
Prof. Amol Gokhale
Prof. Jayathi Y Murthy
Prof. Chandra Venkataraman

Search Committee (Group-2: Electrical Group)

Prof. Nandita Dasgupta (Chairperson)
Dr. Suparna Bhattacharya
Prof. Dipanwita Roy Chowdhury
Prof. S.C. Srivastava
Dr. Archana Sharma
Dr. Anuradda Ganesh
Dr. Sharmila S Mande
Prof. U B Desai
Prof. Laxmidhar Behera
Prof. Debatosh Guha

Inauguration of INAE new Office at DST Complex, New Delhi and Meeting of DST-INAE Consultative Committee

INAE has been provided an office space at the DST Complex, Technology Bhawan, New Delhi and INAE office has since been operational from the DST Complex from August 2, 2021 onwards. The new office of INAE at DST Complex was formally inaugurated by Prof. Ashutosh Sharma, the then Secretary, DST on August 25, 2021 on the side-lines of the DST-INAE Consultative Committee meeting held on that day, for which the following members were present:

- Prof Ashutosh Sharma, Secretary, DST
- Prof Indranil Manna, President, INAE
- Dr Sanak Mishra, Immediate Past President, INAE
- Dr BN Suresh, former President, INAE
- Dr PS Goel, former President, INAE
- Dr Purnendu Ghosh, Vice-President, INAE
- Prof AB Pandit, Vice-President, INAE - attended online on WebEx
- Prof Sivaji Chakravorti, Vice-President, INAE
- Mr Sunil Kumar, Joint Secretary, AI Cell, DST
- Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE

Inauguration of INAE Office by Prof Ashutosh Sharma, the then Secretary, DST

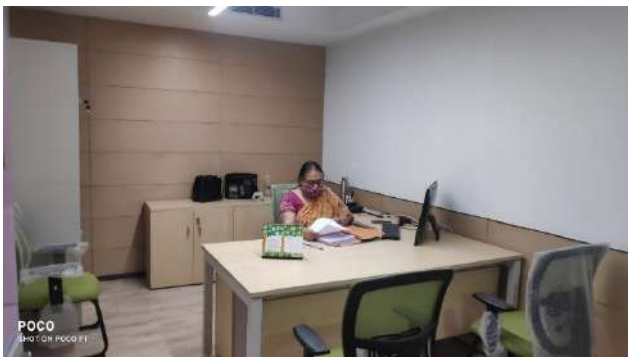
Prof Indranil Manna, President, INAE presenting a bouquet of flowers to Prof Ashutosh Sharma

Left to right, Prof Purnendu Ghosh, Dr PS Goel, Prof Indranil Manna, Prof Sivaji Chakravorti, Prof Ashutosh Sharma, Dr BN Suresh and Dr Sanak Mishra

Tour of INAE Office

DST-INAE Consultative Committee Meeting in progress

A few photographs of the new premises of INAE at are featured below.



Photographs of new INAE Office Premises at Technology Bhavan, New Delhi

Publication of two INAE Compendium for Azadi Ka Amrit Mahotsav

❖ **Compendium on "Landmark Achievements in Engineering and Technology in Independent India"**

The Government of India has launched a 75-week celebration of India's 75th Year of Independence (Azadi ka Amrit Mahotsav) with a grand celebration on 15th August 2022. In this connection, it has been decided that DST will publish a compendium of most significant scientific and technological achievement of India since independence. For this purpose, the Sectoral Group of Secretaries (SGoS) was constituted. The Secretary DBT, Chairperson of the Sectoral Group of Secretaries (SGoS) had requested all Science and Engineering Academies of the country including INAE to join hands and produce an encyclopaedia containing all those feats in Science & Technology that make India proud and will inspire future generations since independence. In this regard, the Presidents of INSA, IASc, NASI and INAE had met on April 3, 2021 and committed to help create a volume and a website that would provide a comprehensive view of India's growth and contributions in S&T since independence. Further, it was decided to solicit suggestions (initially only name or item) to propose a list of 75 or 100 landmark innovations (individual or collective) in S&T in India achieved primarily after our independence, that eminently merit a mention in the proposed volume so as to select deserving items. Suggestions were invited from Fellows/Conveners in this regard.

Subsequently, a meeting was held to consider suggestions received earlier and also to discuss and formalize the methodology to propose a list of 75 or 100 landmark innovations (individual or collective) in S&T in India achieved primarily after our independence that eminently merit a mention in the proposed volume so as to select deserving items. During the said meeting, it was decided that each Convener of the Sectional Committee may request Fellows affiliated to his/her respective Engineering Section to seek 10 to 20 topics of such landmark technical achievements since independence. The inputs received were collated.

A list of suggested topics received for the proposed Compendium on "Landmark Achievements in Science and Technology in Independent India" were discussed in the Steering Committee during its meeting held on 10th June 2021 to shortlist and finalize 3 to 4 topics from each Engineering Section (a total of about 30-40 such engineering accomplishments) proposed to be submitted to DST for inclusion in the said Compendium.

During discussions, the Steering Committee has recommended that INAE may separately publish or contribute in two volumes as Compendium (Collection of Eminent Contributions by Individuals or Group) as given below:

Volume A: Jointly with Science, Medical, Agricultural and other National Academies.

Volume B: 75 (Azadi@75) most outstanding engineering feats or marvels in Independent India (one page each) – only by INAE; Not individual contribution or novelty, but major engineering or technological achievement that has made a huge difference, say, an engineering system or product.

To commemorate "Azadi Ka Amrit Mahotsav", INAE is making efforts to publish a Compendium of most significant engineering and technological achievements of India since independence. A Task Force under the Chairmanship of Prof Prem Krishna, former Vice-President, INAE, constituted with representation from all INAE Engineering Sections to undertake the exercise of publishing the Compendium, has since held meetings on August 14, 2021, August 28, 2021 and September 17, 2021 wherein it was decided that about 75 topics pertaining to "landmark innovation and achievement in engineering and technology" would be identified for further scrutiny. Besides conducting a competition for students, inputs were sought from leading Academic institutions including IITs, NITs, etc and a webpage was designed for this purpose with inputs from Mr K Ananth Krishnan, Chairman INAE Digital Platform Committee. The criteria for selection of items pertaining to landmark achievements in engineering and technology were also specified. Actions were initiated accordingly

and there is good progress on the task being undertaken. The initiative is progressing well and shortly a pruned list of approx. 130 items on landmark achievements in Engineering and Technology shall be made available to the Fellows and Young Associates through the dashboard facility to seek their opinion poll on the suitability of the entries and also three new suggestions, if any. The said Compendium is making good progress to meet the deadline.

❖ **Compendium on "Women Engineers of India Since Independence"**

To commemorate "Azadi Ka Amrit Mahotsav", INAE decided to publish a special Compendium highlighting significant/landmark achievements of 75 women engineers since independence, similar to the one published by Indian Academy of Sciences (Lilavati's daughters). Meetings of the Editorial Committee Chaired by Prof Purnendu Ghosh, Vice-President, INAE, constituted for undertaking the task of publication of Compendium on "Women Engineers of India since Independence" were held on 5th August 2021, 27th August 2021 and 8th September 2021 over WebEx. A Master List of suggested names of women engineers was prepared with inputs received from the Members of the Editorial Committee and Heads of Institutions, in response to letters written by INAE. Several meetings of the Editorial Committee were held, and the actions initiated. The way forward regarding guidelines for selection of nominees and format for preparation of citations of selected women engineers were discussed and actions initiated to progress this initiative. The said Compendium is also making good progress.

Academy Activities

Seminars/Workshops/Conferences –National

The Academy organizes Symposia/Seminars/Workshop/Conferences at national/international levels on topics of national importance. Based on the deliberations, INAE invariably brings out policy recommendations for suitable follow-up action by the concerned Ministry/Department/agency.

❖ **National Frontiers of Engineering (NatFoE 2021) & "Innovation in Manufacturing Practices (IMP)"**

National Frontiers of Engineering (NatFoE 2021)

Indian National Academy of Engineering organized 15th National Frontiers of Engineering (NatFoE) Symposium jointly with IIT Hyderabad on July 9-10, 2021 on virtual platform bringing together 50 bright young engineers to deliberate on emerging technologies in some key engineering sectors. Prof BS Murty, Director, IIT Hyderabad and Prof Sivaji Chakravorti, Vice-President, INAE were the coordinators of the event. Prof Chandrasekhar Sharma, IIT Hyderabad was the Convener of the event.

NatFoE Symposium is an annual flagship event of INAE aiming towards bringing together young engineers from academic institutes, R&D labs and industry on a single platform to deliberate upon emerging trends of research and cutting-edge technologies. About fifty young engineers discussed, deliberated and brainstormed the state-of-the-art knowledge and development, and highlighted the opportunities and challenges in the four major areas:

(i) Artificial Intelligence and Machine Learning

(ii) Advanced materials and Manufacturing Technologies

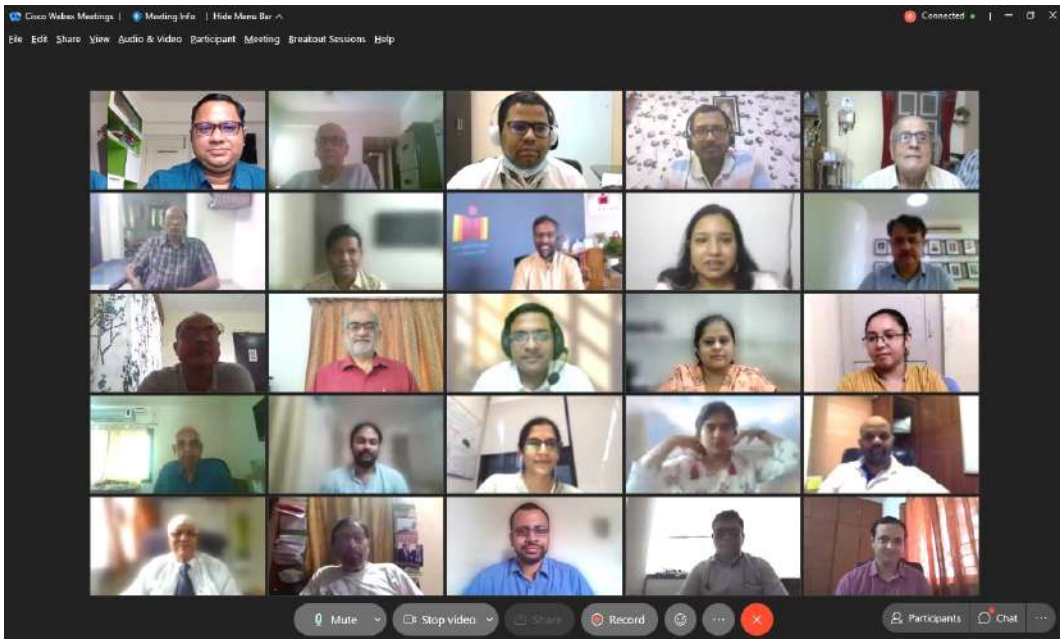
(iii) Infrastructure and Unconventional Energy

(iv) Rural Technology and Entrepreneurship.

All the four themes were chosen carefully as key areas to focus towards making India self-reliant in engineering & technology. As a part of seventy-five years of independence celebrations of India, a special session on 'Azadi Ka Amrit Mahotsava' was also organized in which speakers talked about various indigenous technologies in the area of female hygiene, mitigating greenhouse effects and developing green routes for hydrogen production as an alternative fuel. Another highlight of this session was the model technology to translate English text into 11 Indian languages that may play a key role in translating engineering text books into Indian languages in line with the new education policy to provide technical education in local languages.

Dr. Tessy Thomas, Director General (Aeronautical Systems), DRDO presented a detailed overview on the advances in aerospace materials and manufacturing technologies and highlighted their importance in the success of India's space program. Dr. Debashish Bhattacharjee, Vice President (New Materials Business), Tata Steel in another keynote lecture presented some of the breakthrough technologies and innovations in the area of high strength, lightweight materials for automotive sector.

The symposium started with the welcome address by Prof. B. S. Murty, Director IIT, Hyderabad. Conveying the welcome greetings to the dignitaries and the attendees. Prof. Murty said, "despite the organization of the meeting on a virtual platform due to Covid-19 pandemic, organization of NatFoE2021 will achieve its goal in fostering the new collaborations and exchanging new ideas among the brightest minds and the deliberations will help in unveiling new innovations and the strategies for their commercialization paving the way for the country to become a leader in technology innovations ".



Inaugural Session of the 15th National Frontiers of Engineering Symposium held on July 9, 2021

Congratulating IIT Hyderabad for its efforts in organizing NatFoE, as an online event for the first time, Prof. Indranil Manna, President, INAE said the INAE will take appropriate steps in implementation of the recommendations and action items in the four themed areas as a final outcome of this symposium. As a satellite event of NatFoE 2021, a national design competition event, Innovations in Manufacturing Practices (IMP) was also organized for UG and PG students as well as start-ups. Out of 160 entries, 6 award winners were chosen. Prof. Sivaji Chakravorti, Vice President, INAE declared the award winners in each category and congratulated them for their innovation and extended further support to take them to the next level. Dr. Chandra Shekhar Sharma, Coordinator, NatFoE 2021 extended a vote of thanks to all speakers & participants, INAE Fellows and Young Associates and other guests for their active participation to make the NatFoE 2021 a grand success.

The links for the Online News Coverage of Press Releases for the NaTFoE 2021 Symposium are given below:

Hyderabad: IITH-INAE Jointly Organizes 15th NATFoE-2021 Concludes Successfully
https://www.globalgreenews.com/2021/07/12/15231/

IITH & INAE jointly organized the 15th National Frontiers of Engineering symposium, NATFoE, 2021
https://www.thehawk.in/education/iit-hyderabad-inae-jointly-organized-the-15th-national-frontiers-of-engineering-symposium-natfoe-2021-238137

IIT Hyderabad & INAE jointly organize NATFoE 2021
https://www.pallikkutam.com/edu-news/iit-hyderabad-inae-jointly-organizes-natfoe-2021

50 bright, young engineers on a common platform
https://www.thehindu.com/news/cities/Hyderabad/50-bright-young-engineers-on-a-common-platform/article35285417.ece

IIT Hyderabad, INAE jointly organises 15th National Frontiers of Engineering symposium 2021
https://www.abpeducation.com/news/iit-hyderabad-inae-jointly-organises-15th-national-frontiers-of-engineering-symposium-2021/cid/1210035

A Report was prepared on 15th National Frontiers of Engineering (NatFoE) Symposium and also a White Paper based on the deliberations.

Innovation in Manufacturing Processes (IMP-2021)

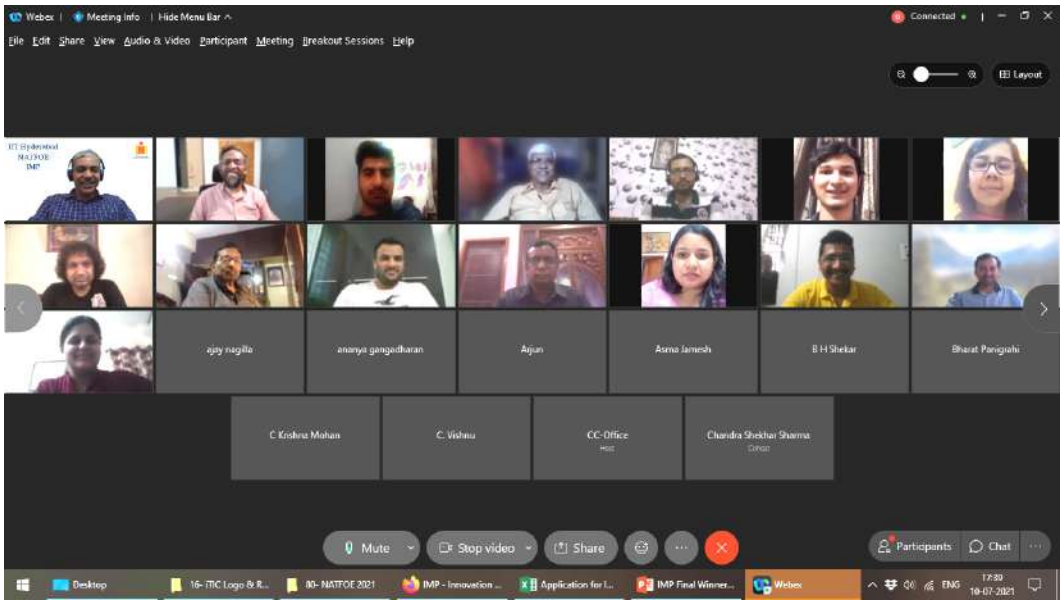
Innovation in Manufacturing Processes (IMP), conducted by INAE and IIT Hyderabad jointly as a satellite event along with 15thNatFoE symposium, is a national level project competition open to all engineering students and practitioners. In addition to undergraduate and postgraduates (Master's students) categories, start-ups were also included as a new category this year. In the UG and PG category, the eligible branches were Aeronautical, Biomedical, Chemical, Civil, Computer/Information, Design, Electrical, Electronics, Industrial, Instrumentation, Material Science, Mechanical, Power, Production and other allied branches. Entrepreneurs-in-Residence (EiR) and Start-ups with less than two years and incubated at any of the Technology Business Incubators (TBI) in India were eligible in the Start-up category. In each of these categories, the award included a prize of Rs. 40,000 and Rs. 20,000 for first and second place winners, respectively. The event was coordinated by Prof. S. Surya Kumar and INAE Young Associate Dr. Mudrika Khandelwal of IIT Hyderabad.

Entries to this competition were taken in the form of a short video and a small write-up, floated through an online application portal which remained open from 1st April to 15th June. Based on the preliminary screening, out of 150 entries, 24 were selected for the "Virtual Showcasing" where the submitted project videos are hosted on a dedicated webpage (https://www.iith.ac.in/natfoe2021/imp/) as a run-up to the competition.

The winners were selected from these 24 applications by an eminent jury comprising of INAE Young Engineer awardees and chaired by Prof. Sivaji Chakravorti, Vice-President INAE. The jury included Dr. Amartya Mukhopadhyay (IIT Bombay), Dr. Aravind Kumar Rengan (IIT Hyderabad), Dr. Chirasree Roy Chaudhuri (IIEST, Shibpur), Dr. Pooja Devi (CSIR-CSIO) and Dr. Swati Ghosh Acharyya (University of Hyderabad).

On the day-1 of the NaTFoE event (9th July in the 12:00 to 13:00 session), videos of the selected applicants were showcased as part of the event. The final winners were announced on the day-2 of the NaTFoE (10th July in the 17:00 to 17:45 session) by Jury-Chair, Prof. Sivaji Chakravorti. The list of winners is given below:

- **UG Category:**
  - First Prize: Nitheesh P, Surya Bharath for "Natural fiber extraction Machine for Sustainable Development (Pineapple Fiber)" (affiliation: KCG College of Engineering, Chennai)
  - Second Prize: Mohammed Safi A for "An Autonomous Drowning Rescue System (One's SEGAIN)" (affiliation: Sri Venkateshwara College of Engg, Sriperumbudur)
- **PG Category:**
  - First Prize: Mayank Kanubhai Patel for "Novel Approach for 3D printing of High Strength Al7075 alloys" (affiliation: IIT Kanpur)
  - Second Prize: Prashanth M, Nayana Kumari JR, Chaithra D for "Development of low-cost falling weight deflectometer" (affiliation:M S Ramaiah University of Applied Science, Bengaluru)
- **Startup Category:**
  - First Prize: Refaz Ahmad Wani, Shugufta Akhter, Ishfaq Ahmad Wani for "Spade and Hoe" (affiliation: Wani Agri Tools Plant, Anantnag, J&K)
  - Second Prize: R Sai Chandra Teja, C Krishna Mohan, C Vishnu for "State-of-the-art Multi-class Wafer Defect Detection & Segmentation in Semiconductor Manufacturing" (affiliation: CKM Vigil Pvt Ltd, Hyderabad)

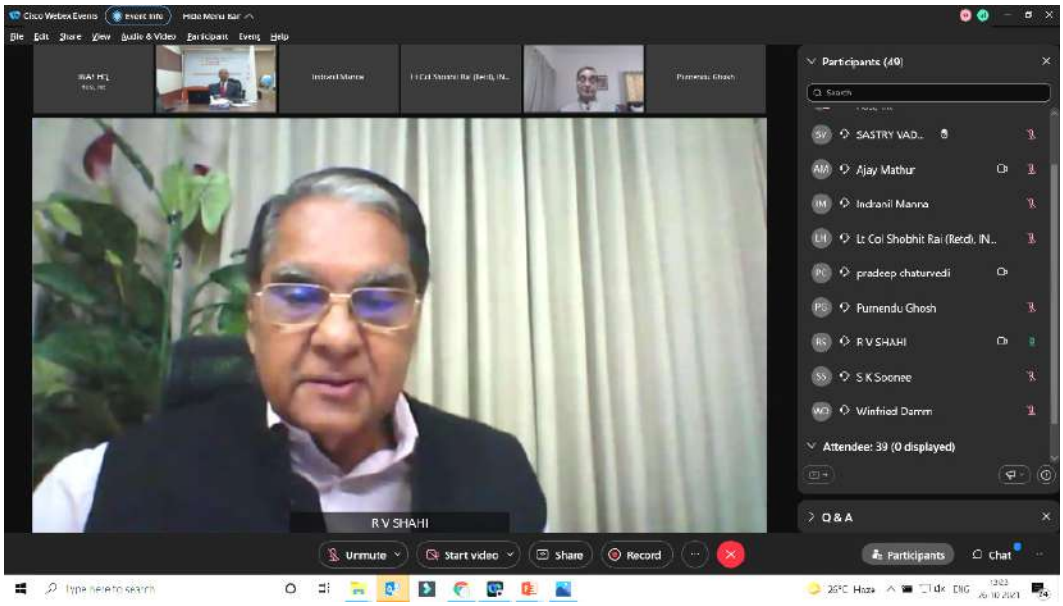


Screenshot of the Final Award event for IMP-2021(July 10, 2021)

INAE Engineers Conclave 2021

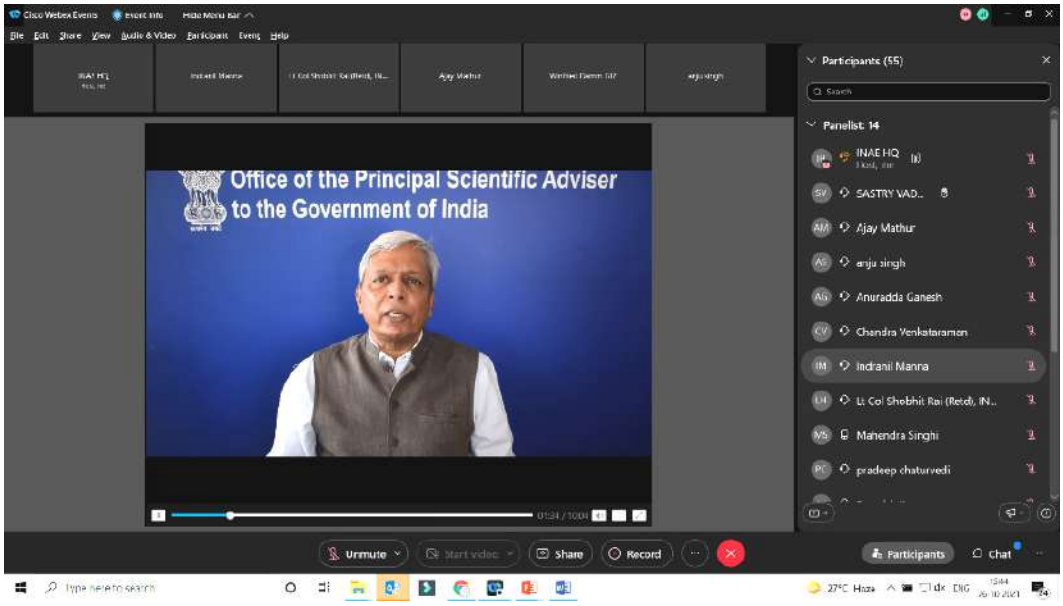
INAE organizes an annual mega event of engineers as "Engineers Conclave" jointly with major engineering organizations on rotation basis. The objective of the Engineers Conclave is to provide a platform for engineers and technologists from allied fields to meet, deliberate and recommend right engineering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

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



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

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



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

The first Plenary talk was delivered on October 26, 2021 by Lord Adair Turner, Chair, Energy Transitions Commission, UK on 'Global picture on scenarios to achieve 1.5 degrees and net zero'. The Second Plenary Talk was delivered on

October 27, 2021 on "Dilemmas at the Intersection of Scientific Temper and Engineering Ethics" by Prof VM Naik, Department of Chemical Engineering, IIT Bombay.

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

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

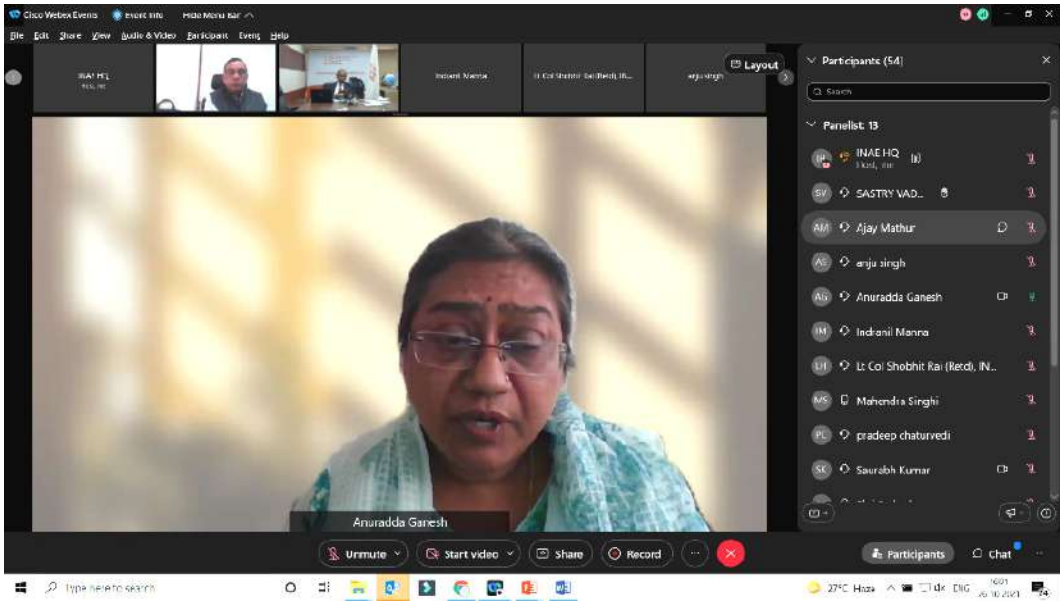
Shri TV Narendran, CEO & MD, Tata Steel was the Key note Speaker of Technical Session-III: De-carbonizing heavy industry

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

(a) Technical Session-I: Energy Transitions: Integrating RE technologies in the electricity sector

(b) Technical Session-II: E-mobility solutions for the transport sector

(c) Technical Session-III: De-carbonizing heavy industry



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

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

(a) Technical Session-I: Super/Megastructures Civil Engineering

(b) Technical Session-II: Amrit moments in Chemical Engineering

(c) Technical Session-III: Amrit moments in Electronics/ Computer Engineering

(d) Technical Session-IV: Amrit moments in Strategic Sector

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

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

Seminars/Workshops/Conferences – International

5th INAE-NAEK Workshop on 'What's next in Aerospace Engineering and Materials' held virtually on June 14, 2021 – June 15, 2021

A series of collaborative activities had been organized jointly between the Indian National Academy of Engineering and National Academy of Engineering of Korea (NAEK), South Korea since 2017. The first Workshop between INAE and NAEK was held on 'High Temperature Materials' on March 16-17, 2017 at IISc Bangalore, India. The second Workshop on 'High Temperature Materials' was held on May 14-15, 2018 at Changwon, Korea. The third INAE-NAEK Workshop on "High Temperature Materials and System Engineering for Aerospace, Power Generation and Defence Industry" was held on 15-17th July 2019 at Hyderabad. To continue with the tradition, the fourth Workshop on "What's next in Aerospace Engineering and Materials" was held virtually on June 14-15, 2021 to commemorate celebration of India's 75th Year of Independence (Azadi ka Amrit Mahotsav).

The Workshop started with the Welcome Address by Prof Kwon, Oh-Kyoung, President, NAEK followed by the Opening Address was delivered by Prof Indranil Manna, President, INAE and the workshop focussed broadly on the following three domains:

(i) Session I: Aerospace Engineering systems and Aerodynamics

(ii) Session II: Innovation for Materials in Aerospace industry

(iii) Session III: Additive Manufacturing for Aerospace industry

The details of the session are given below.

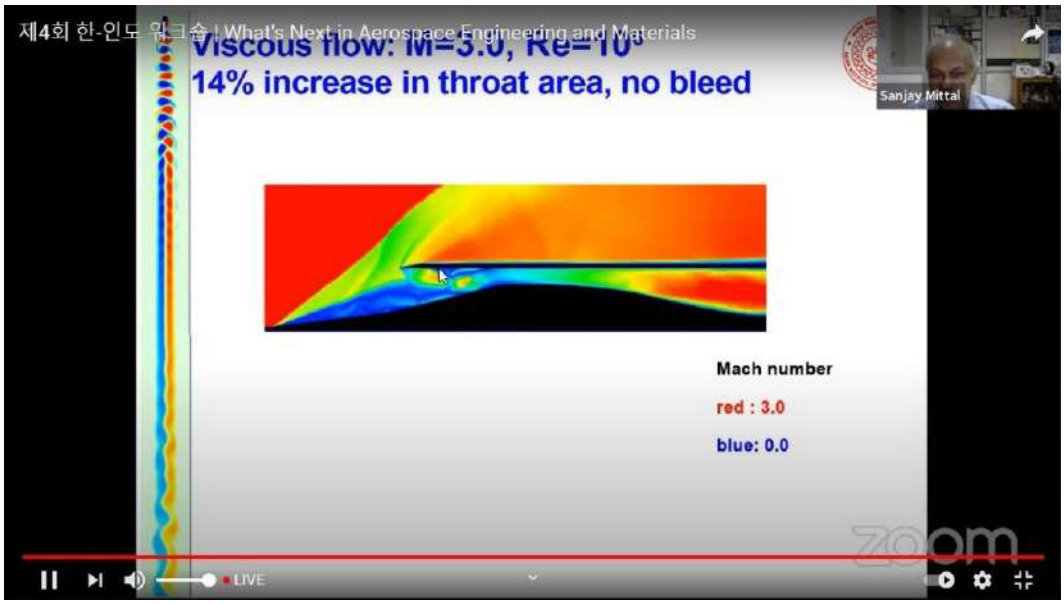
I. Date: 14 June 2021, Session I

The first session was chaired by Prof Hyoun Jin Kim, Department of Mechanical and Aerospace Engineering, Seoul National University.

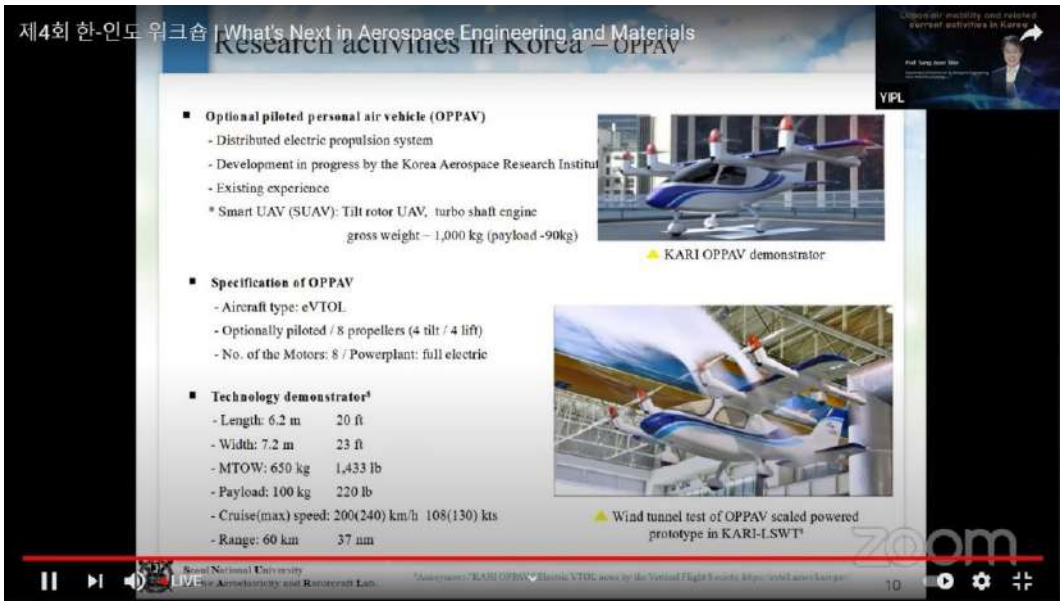
The details of the talks delivered are given below:

S No.	Details of the Speaker	Topic
1.	Prof Yung-Gyo Lee, Director, Aeronautics Technology Research Division, Korea Aerospace Research Institution (KARI)	Korean Solar Powered Stratospheric UAV Development
2.	Prof Sanjay Mittal, Department of Aerospace Engineering, Indian Institute of Technology Kanpur	Air Intakes of High-Speed Aircrafts and Reusable Launch Vehicles
3.	Prof Sang Joon Shin, Department of Mechanical & Aerospace Engineering, Seoul National University	Urban air mobility and related current activities in Korea

Opening Address by Prof Indranil Manna, President, INAE



Presentation by Prof Sanjay Mittal



Presentation by Prof Sang Joon Shin

2. Date: 14 June 2021, Session II

The second session was chaired by Prof Young-Chang Joo, President, Advanced Institute of Convergence Technology / Professor, Department of Materials Science and Engineering, Seoul National University. The details of the talks delivered are as under:

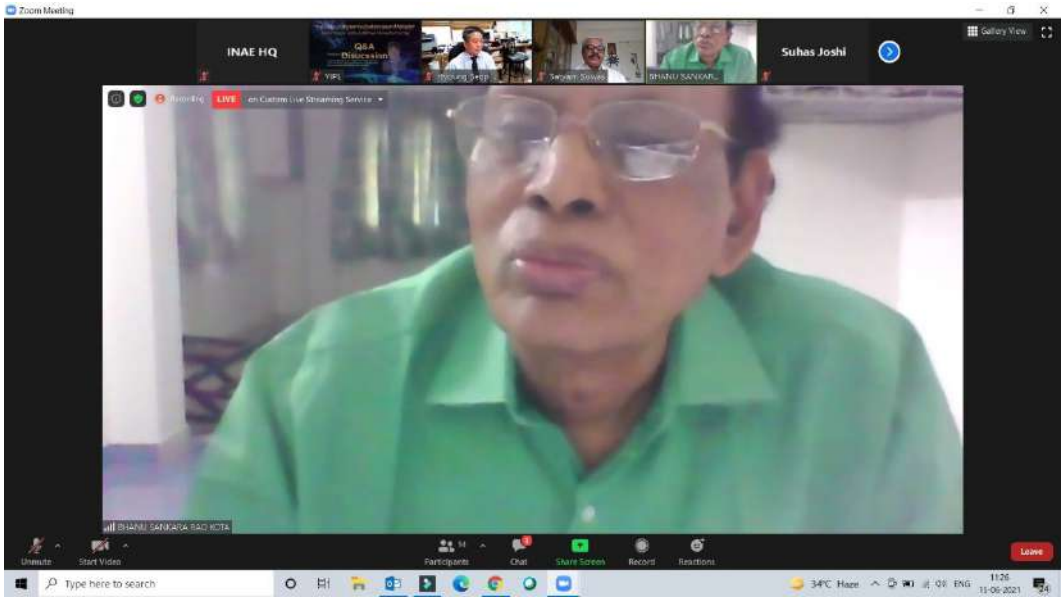
S No	Details of the Speaker	Topic
1.	Prof Dipankar Banerjee, Department of Materials Engineering, Indian Institute of Science, Bangalore	Aerospace Materials in India: Past, Present and Future
2.	Dr Yong-Nam Kwon, Principal Researcher, Korea Institute of Materials Science (KIMS)	The current status of Korean aerospace materials industry - Do we really have to run domestic supply chain
3.	Mr S Somanath, the then Director, Vikram Sarabhai Space Centre, Thiruvananthapuram	Materials development for Indian Space Program

II. Date :15 June 2021, Session III

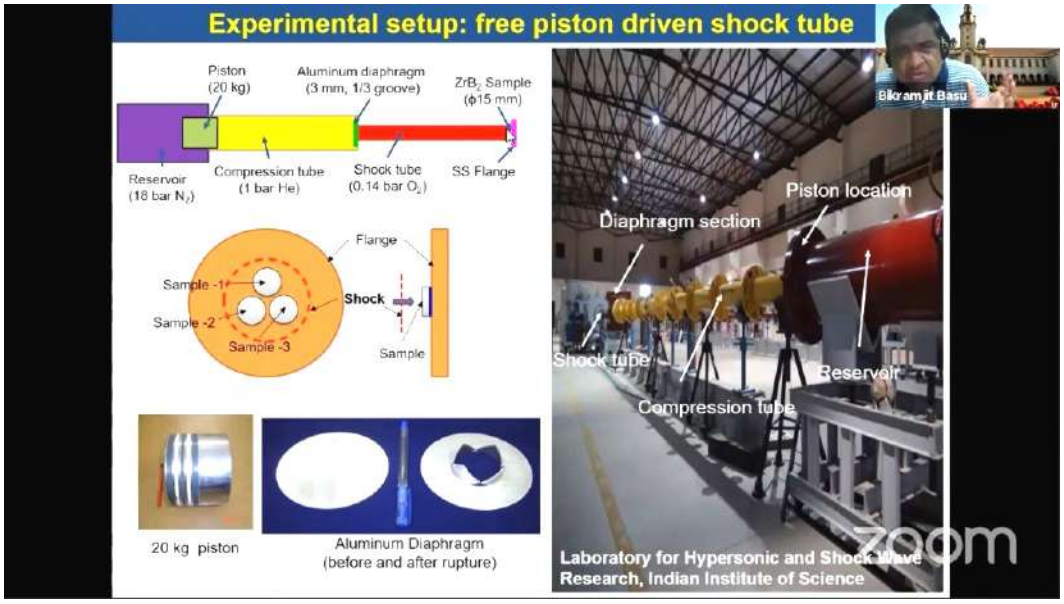
The third session was chaired by Prof K Bhanu Sankara Rao, FNAE, School of Engineering Sciences and Technology, University of Hyderabad. The details of the talks presented are given below:

S No	Details of the Speaker	Topic
1.	Prof Bikramjit Basu, Honorary Professor, University of Manchester, UK; and Professor, Materials Research Centre, Indian Institute of Science, Bangalore	Ultrahigh Temperature Ceramics for Aero structural Applications
2.	Dr Jongkee Ahn, Principal Research Engineer/Team leader, Advanced Material Design Team, Hanwha Aerospace R&D center	Present status and future prospects of additive manufacturing for gas turbine in Korea
3.	Prof Suhas S Joshi, Department of Mechanical Engineering, Indian Institute of Technology Bombay, Mumbai	Generating Multi-scale Functional Surfaces using Laser Micromachining

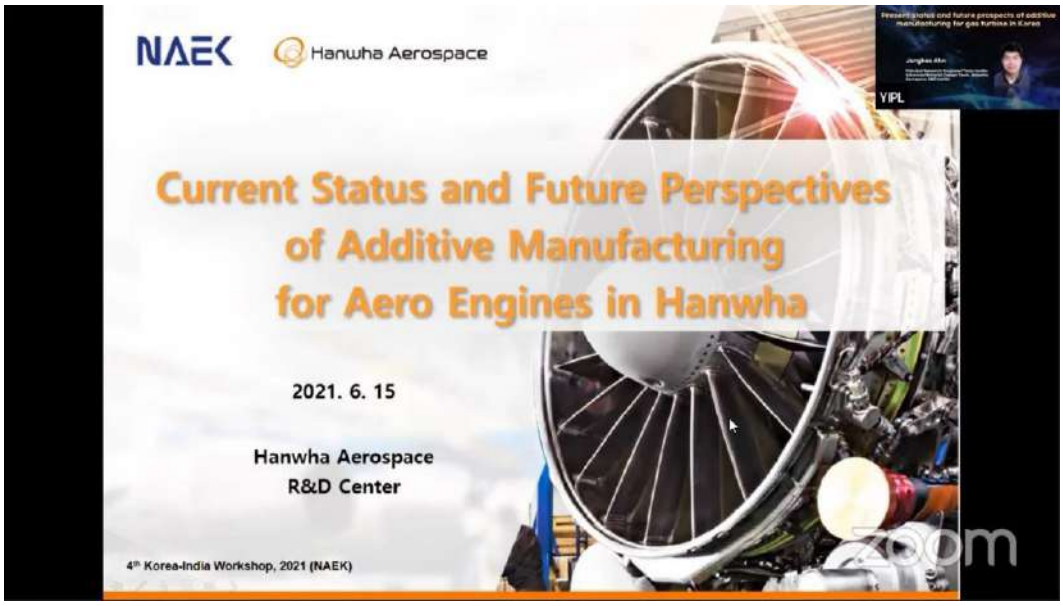
4.	Prof Hyoung Seop Kim, Professor, Department of Materials Science Engineering, Pohang University of Science and Technology (POSTECH)	Metal Additive Manufacturing for Heterogeneous Architectured Materials
5.	Prof Satyam Suwas, Department of Materials Engineering, Indian Institute of Science, Bangalore	Additive manufacturing of materials for high temperature applications
6.	Dr Keejoo Lee, Senior Researcher, Head of Small Launcher Team, Future Launcher R&D Program Office, Korea Aerospace Research Institute	Embracing Digital Transformation of Rocket Technology with Additive Manufacturing



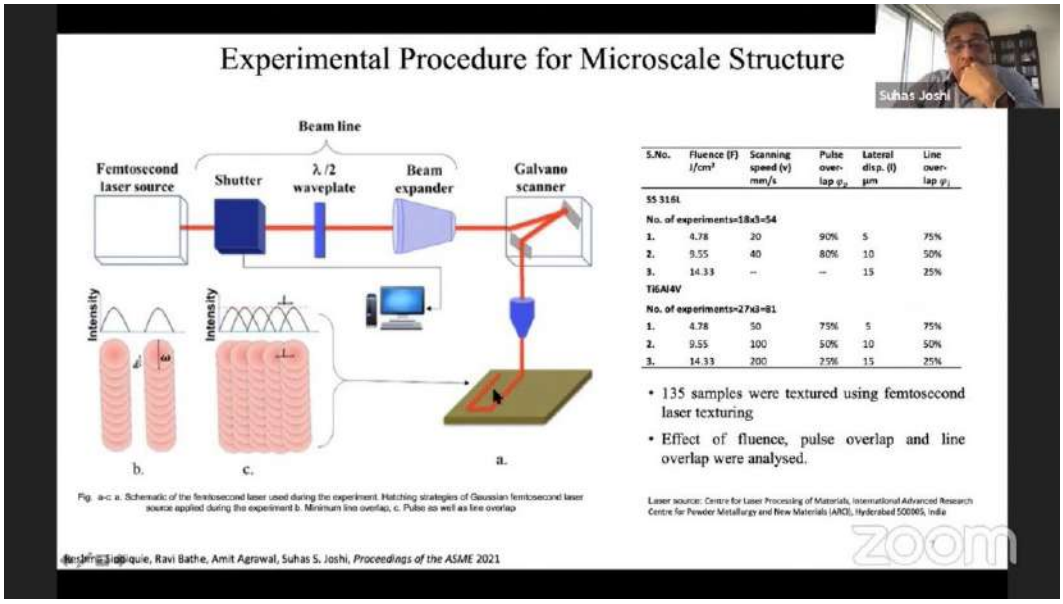
Chairing of Session by Prof K Bhanu Sankara Rao



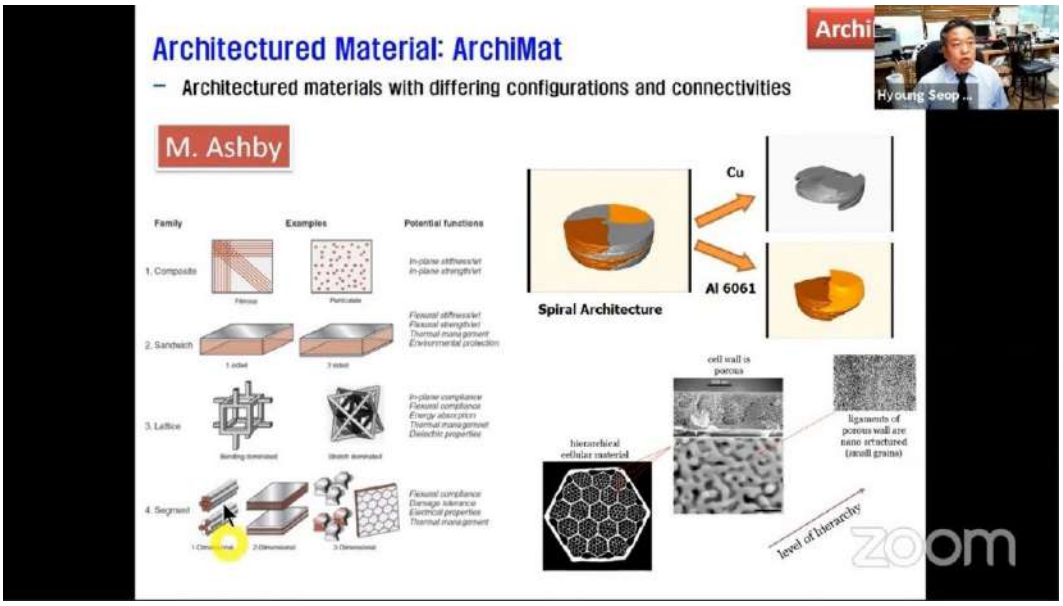
Presentation by Prof Bikramjit Basu



Presentation by Dr Jongkee Ahn



Presentation by Prof Suhas Joshi



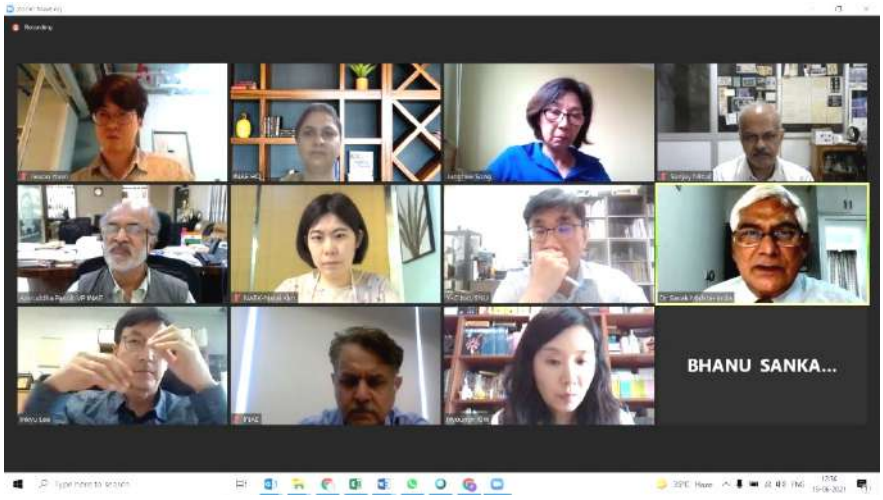
Presentation by Prof Hyoung Seop Kim

Presentation by Prof Satyam Suwas

Presentation by Dr Keejoo Lee

Each session was followed by the Q&A Session. The Workshop concluded with the Wrap up Session which was chaired by Dr Sanak Mishra, Immediate Past-President, INAE and attended by the following members from INAE and NAEK:

NAEK Participants	INAE Participants
1. Dr Song, Jung Hee, Vice President, NAEK	1. Prof AB Pandit, Vice-President, INAE
2. Prof Inkyu Lee Chair of International Affairs, NAEK	2. Prof K Bhanu Sankara Rao, Chief Editor of Publications, INAE
3. Prof Young-Chang Joo, Member, NAEK	3. Prof Sanjay Mittal, Fellow, INAE
4. Prof Hyounjin Kim, Member, NAEK	4. Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE
5. Ms Narai Kim, Senior researcher, NAEK	5. Ms Pratigya Laur, Research Officer, INAE
6. Mr Jiesoo Yoon, Researcher, NAEK	



Concluding Session

Other Activities/Affairs of INAE

Frugal Innovation Nurturing Program (FINP)

Background:

Frugal Innovation Nurturing Programme (FINP) is an initiative by INAE since 2018, to promote Frugal Innovations in the country. Grassroots innovations are basically innovative solutions developed to overcome certain challenges, during the course of the day- to- day activities for sustainability by citizens. These activities could be in the domain of farming, energy, water, health, medicine, entertainment, handcrafts, transport, electronics, village skills, greener technologies etc. mostly driven by necessity or curiosity of the people in the informal sector. They are basically to be seen as bottom-up solutions in response to the local situations linked to the interests and values of the communities involved. This fact is to be accepted because the grassroots innovators are not trained engineers and they developed these innovations through trial and error out of their sheer zeal and with limited local infrastructure available to them. They do not have means and mechanisms to take their innovation to a larger scale and commercialize them for greater benefit across the country.

With this background, a MoU between INAE and National Innovation Foundation (NIF) was signed and Innovation Promotion Committee with representation from NIF was constituted. The committee identifies certain impactful innovations with the help of National Innovation Foundation (NIF) that have reached prototype stage (TRL 4-5) and have been successfully tried in the field but were limited in out-reach owing to limited infrastructure/means available with the inventor. The committee then organizes design, upgradation for TRL 8-9 compliance and identifies suitable industry for seamless production and commercialisation. The committee also bridges the gap between the innovator, industry and the end user with the help of S&T institutions, Agricultural Universities, Krishi Vigyan kendras etc. INAE had signed an MOU with NIF for collaboration and mutual support in jointly implementing this program.

The following grassroots projects of TRL 4-5 had been identified recently under this programme and upgraded to TRL 8-9 through S&T intervention with the support of academic institutions as given below.

(i) Improved the design of a tractor driven paddy planter from TRL 5 to TRL 8 of a grassroots inventor for seamless commercialization purpose with the support of IISc, Bangalore faculty. NIF is also involved throughout the work. M/s John Deere India has agreed to manufacture and market this product across India. John Deere signed agreement to this effect with the grassroot Innovator by paying the agreed royalty.

(ii) Intelligent Glasses for the profoundly blind with the support of MVJ College of Engineering, Bengaluru

(iii) Solar Iron cart with the support of RVS College of Engineering, Bengaluru

(iv) Automated Agriculture Pesticide Sprayer with the support of MVJ College of Engineering, Bengaluru

(v) Walnut cracker with the support of IISc, Bengaluru

Besides above-mentioned projects completed so far, the following projects are under progress in various institutions:

(i) Rapid Compost Making Machine at MVJCE, Bengaluru

(ii) Design and implementation of Air cooler cum mosquito trap at RVCE, Bengaluru

(iii) Maize Grinding Machine at MVJCE, Bengaluru

(iv) Solar Based Motorized Fruit and Vegetable Harvesting Device, RVCE, Bengaluru

(v) Motorised pepper harvesting machine, GITAM College of Engg, Visakhapatnam

(vi) Foldable Trolley, MVJCE, Bengaluru

A few more projects are in process of consideration and are being reviewed. The work so far done is restricted to Bangalore based institutions for close study and to understand the intricacies involved to start with. However, the grassroots innovations are sourced from different places in the country. Several S&T institutions have shown keen interest and from the feedback received it is felt that faculty/students are enthused at the prospect of having to deal with different kinds of practical application-oriented projects. The present policy is that IPR (Intellectual Property Rights) remains with innovator unless substantial design changes have been made by the institution as per requirement demands. In that case, joint patenting would be permitted under the purview of NIF. The MOU between INAE and NIF was extended for another 3 years to support FINP program on July 15, 2021.

INAE's 35th Foundation Day Celebrations

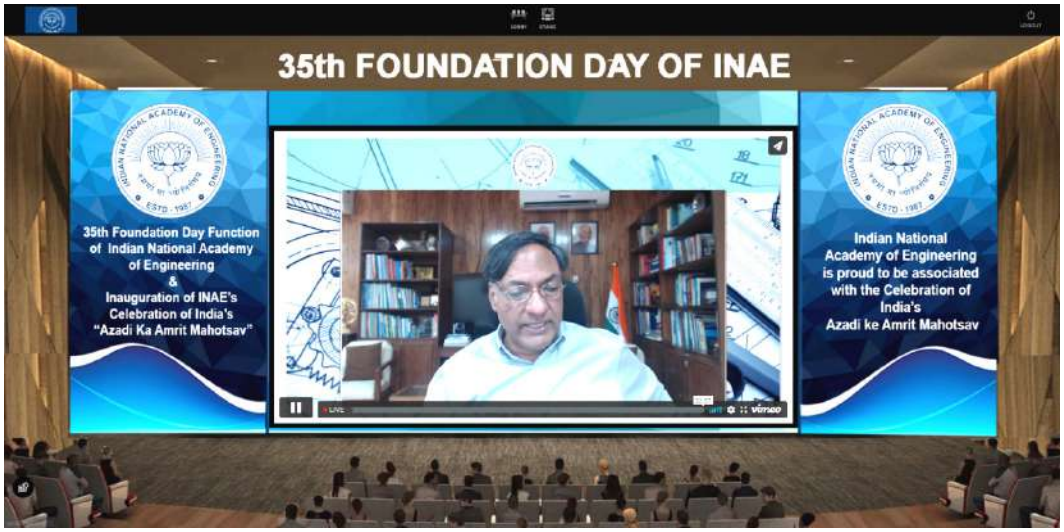
Special lectures on the 35th Foundation Day of INAE and inauguration of the India's "Azadi Ka Amrit Mahotsav" celebration by INAE held online on 20th April 2021

The Indian National Academy (INAE) was founded on 20th April 1987 to promote excellence in Engineering and Technology (E&T) in the country. INAE celebrated virtually its 35th Foundation Day coinciding with inauguration of the Azadi Ka Amrit Mahotsav on 20th April 2021 from 4.00 PM to 6:30 PM. The Government of India (GoI) has launched a nation-wide 75-week long celebration of the 75th Anniversary of India's independence (Azadi Ka Amrit Mahotsav) on 12th March 2021 to conclude on 15th August 2022. Brief details of the event are given below.

Prof Ashutosh Sharma, FNAE, Secretary, DST was the Chief Guest of the event. Prof Indranil Manna, President, INAE delivered the Welcome Address. Prof Indranil Manna expressed his gratitude towards Prof Ashutosh Sharma and distinguished speakers for sparing the valuable time and gracing the event. In his Welcome Address he gave a brief history of INAE and its recent activities and importance of engineers in the society. The Inaugural Address was delivered by Prof Ashutosh Sharma, Chief Guest of the Foundation Day Celebration. Prof Sharma highlighted the difference between science and engineering and its applications. He stressed that as the future throws challenges at greater speed, the Indian National Academy of Engineering (INAE) should play the role of think tank for the development and progress of country and to help common men reap the benefits of science, technology and innovation, at the 35th foundation day of INAE.

"Some of the major challenges of the future are related to sustainable development, climate, energy, role of intelligent machines, internet of things, industry 4.0 and society 5.0 and man's future competition with machines for which we have to look for future technologies," Professor Sharma said. He added that engineering is a tool to discover new science and a whole lot of science and technology could be built on knowledge, could be inter-disciplinary and problem-solving is the key for future. "The future is all about conversion of technologies. Leadership in engineering must acquire a holistic vision. INAE should play the role of think tank for the development and progress of the country," he mentioned. Expressing concern at the limited number of women in engineering and science, he hoped that the upcoming Science, Technology and Innovation Policy (STIP) would encourage more women in this field as it strongly advocates for diversity, inclusion and equity. "Science has to be democratised, including engineering. INAE should think about how to encourage women to take up engineering," he emphasised.

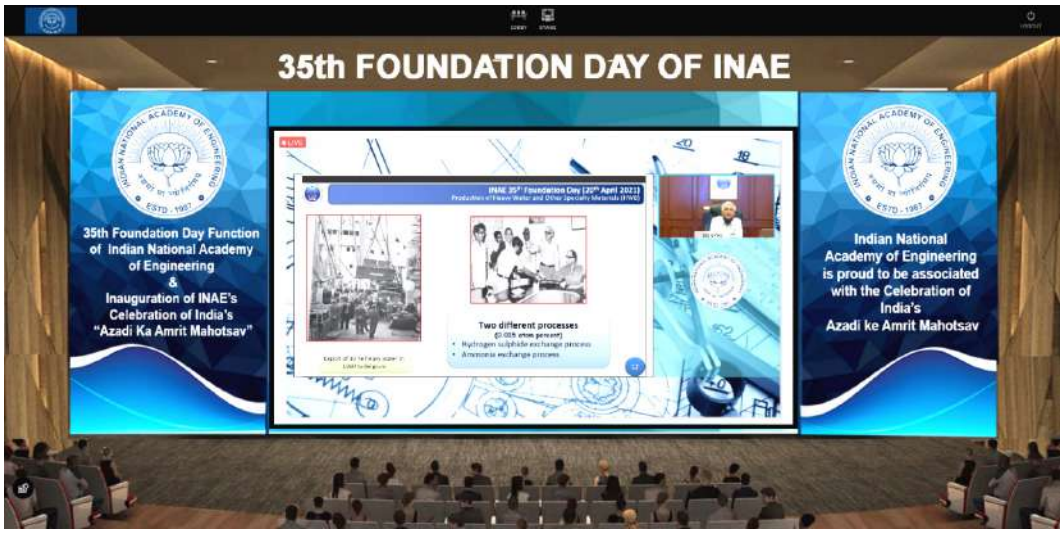
Welcome Address by Prof Indranil Manna, President, INAE



Prof Ashutosh Sharma, FNAE, the then Secretary, DST,
Chief Guest of the Foundation Day Celebration delivering Inaugural Address

To commemorate the occasion, special lectures were delivered by four eminent speakers highlighting the biggest technological achievements in their respective fields of specialisation that have made India proud and would serve to inspire the youth and posterity to scale greater heights in E&T and make the Honourable PM's vision of Atmanirbhar Bharat. The dignitaries highlighted how the technological achievements of their organizations have helped make "Atmanirbhar Bharat" a reality as given below.

Shri KN Vyas, FNAE, Secretary, Department of Atomic Energy (DAE) & Chairman, Atomic Energy Commission (AEC), Mumbai delivered the lecture on "Efforts Towards Indigenisation of Different Technologies in Department of Atomic Energy". He highlighted DAE's work on exploration of atomic minerals, mining and concentration of atomic minerals, design and construction of nuclear reactors, safe operation of nuclear reactors, spent fuel reprocessing, production of heavy water and specialty materials, instrumentation and control of nuclear power plants; Research related to Cyclotrons; Research related to Synchrotrons, Linear Accelerators and lasers and Research in nuclear agriculture and radio-pharmaceuticals.



Lecture by Shri KN Vyas, FNAE, Secretary, Department of Atomic Energy (DAE) & Chairman, Atomic Energy Commission (AEC), Mumbai

Dr G Satheesh Reddy, FNAE, Secretary, Department of Defence R&D and Chairman, Defence Research and Development Organisation delivered the lecture on "DRDO: A Technology Journey towards Self Reliance in Defence Systems". He shared the technical journey of DRDO from the year 1958 onwards and highlighted how DRDO leverage intellectual capital across the country. He also talked about the contribution of DRDO in the journey of self-reliance in defence system including their achievements in missiles, fighter aircrafts, tanks and combat vehicles, radars and sonars, electronic warfare systems, torpedoes, mines and decoys, artillery guns, arms and ammunition, cyber systems, LIC handling products, space systems, soldier support systems and communication systems.

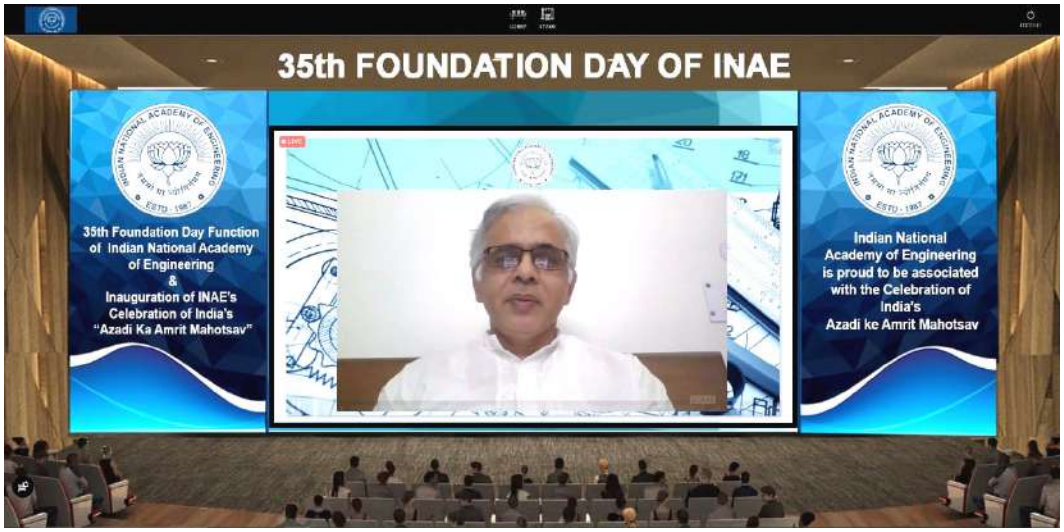
Presentation by Dr G Satheesh Reddy, FNAE, Secretary, Department of Defence R&D and Chairman, Defence Research and Development Organisation

Shri S Somanath, FNAE, Director, Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram delivered the lecture on "Accomplishments of ISRO in Space Technology Projects – Research & Application delivery". Shri S Somnath highlighted that Indian Space Research Organisation (ISRO) has the primary responsibility of leading the research and development of space science, technology and applications towards holistic development of the

Nation. He highlighted that self-reliant and robust telecommunication, meteorology and space-based imagery assets are established in the country along with precision regional navigation system, NavIC. Space science and planetary exploration missions are being pursued to open-up new horizons. ISRO operational fleet of launch vehicles assures sustained access to space and global competitiveness. Advanced launch vehicle & spacecraft developments are taken up for capability enhancement. Gaganyaan, the Indian human spaceflight programme will enable human presence across the solar system. He talked about people-centric and application-driven space technologies that include human spaceflight, space commerce, space applications, capacity building, space infrastructure and space transportation.

Lecture by Shri S Somanath, FNAE, Director, Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram

Dr Shekhar C Mande, FNA, Secretary, Department of Scientific & Industrial Research (DSIR) and Director-General, Council of Scientific & Industrial Research (CSIR), New Delhi delivered the lecture on "The role of S&T in development of modern India". Dr Shekhar C Mande shared the overall vision of CSIR, contributions of CSIR over the years in addressing National challenges and carving out Global S &T niches and agenda for the future. He also spoke about CSIR's efforts and invention in the fight against pandemic COVID-19.



Lecture by Dr Shekhar C Mande, FNA, Secretary, Department of Scientific & Industrial Research (DSIR) and Director-General, Council of Scientific & Industrial Research (CSIR), New Delhi

Prof Purnendu Ghosh, Vice-President, INAE proposed the Vote of Thanks, followed by National Anthem of India. The event was attended online by more than 350 participants. The event was widely publicized on social media.

Documentary film on INAE

At the behest of DST, the Vigyan Prasar had coordinated a series of films made on various institutes of DST including INAE. In this connection, Vigyan Prasar, DST informed INAE regarding release of film on INAE on Wednesday, 26th May 2021 to be watched on India's 24x7 national science channel on the internet, called India Science (www.indiascience.in) . The English and Hindi versions of the film can be viewed by clicking on the links given below:

https://www.indiascience.in/videos/dst-inae-e

https://www.indiascience.in/videos/dst-inae-h

Peer Committee for "Technological Preparedness for dealing with National Disruptions"

INAE had prepared a White Paper on "Technological Preparedness for dealing with National Disruptions". Dr. B.N. Suresh, former President, INAE had prepared the base paper in this regard, with inputs from Dr. P.S. Goel, former President, INAE, Dr. Bhujanga Rao, FNAE and other domain experts from INAE Fellowship. The White Paper on "Technological Preparedness for dealing with National Disruptions" integrating all the inputs was compiled by Dr BN Suresh and forwarded to Shri Amitabh Kant, CEO, NITI Aayog; Dr VK Saraswat, Member, NITI Aayog; Prof K VijayRaghavan, PSA to Govt. of India and Prof Ashutosh Sharma, Secretary, DST, Govt. of India with a request for an opportunity of consulting with them over a WebEx meeting to take this initiative forward. In response to this initiative, NITI Aayog convened a meeting, through 'Video Conferencing' on 10th August 2020 chaired by Dr. VK Saraswat, Member, NITI Aayog to discuss the future course of action to implement the recommendations of the White Paper on 'Technological Preparedness for dealing with National Disruptions', with a view to take the initiative forward. It was suggested that a Peer Committee be constituted with member experts from INAE and NITI Aayog who would further identify Sub-committees to take up specific task envisaged to take this initiative to its logical conclusion.

Accordingly, a high-level Peer Committee was constituted under the chairmanship of Dr PS Goel, Former President, INAE with the purpose to bring out a roadmap to recommend a mechanism to maintain an up-to-date dashboard in the public domain and easy-to-access data base on history, experts, facilities, and archives related to all kinds of disasters. The Committee now also has representation from NDMA besides other agencies viz DST, CSIR, ICMR, DRDO, DAE, ISRO, ICG and DBT. Several meetings of the Peer Committee were held so far in order to review the progress achieved on the initiative. Six expert Committees were constituted so as to specifically focus on the respective domains. A meeting of the Peer Committee was held on May 14th, 2021 wherein five out of six Chairmen of following Expert Committees made presentation on the progress:

- Atmosphere and Climate related disasters chaired by Dr Mrutyunjay Mahapatra
- Geology related disasters chaired by Dr VM Tiwari
- Health related disasters chaired by Dr Chander Shekhar
- Ocean related disasters chaired by Dr M Ravichandran
- Fire related disasters chaired by Dr Rajiv Narang

The report is under finalization and is an important initiative which shall play a major role in enhancing the visibility of INAE, as an advisory body in the policy domain.

Webinars/Events conducted by INAE

(i) Special Lecture by Dr Sethuraman Panchanathan, Director, National Science Foundation, USA on 31st July 2021 (Saturday)

Dr Sethuraman Panchanathan, Director, National Science Foundation, USA delivered a special lecture on "Creating Foundational Partnerships: Building on the strength of US-India collaboration towards a roadmap for the future" during the INAE Webinar held on 31st July 2021 (Saturday) from 7 PM to 8 PM (IST). Prof. Indranil Manna, President INAE, Vice-Chancellor, Birla Institute of Technology (BIT), Mesra delivered the Welcome Address during the Webinar. Prof Sivaji Chakravorti, FNAE, Vice-President, INAE, Electrical Engineering Department Jadavpur University, Kolkata was the Moderator of the Webinar.

Dr Sethuraman Panchanathan, Director, NSF, USA delivering the Special Lecture

Abstract of the Special Lecture:

For more than a decade, cooperation between the United States and Indian science and engineering communities has pushed forward the frontiers of discovery and innovation. From materials research and sustainable urban systems to space technology and beyond, various engineering research areas have benefited from this collaboration. Formal mechanisms for cooperation, which have existed for nearly 20 years, coupled with National Science Foundation (NSF) investments in a wide range of research with Indian scientists and institutions, have facilitated numerous accomplishments and discoveries.

Dr. Panchanathan outlined the state of scientific and engineering collaboration between the United States and India while also elaborating on his vision for the future of NSF. This includes the importance of ensuring accessibility and inclusivity in STEM fields across the United States and India and advancing technological progress through the continued translation of curiosity-driven, discovery-based research. Building on the firm foundation of past US-India science and engineering engagements, Dr. Panchanathan discussed strengthening existing engagements and creating new opportunities for collaboration to accelerate discovery and innovation at speed and scale.

Brief Bio of the Speaker:

Dr. Sethuraman Panchanathan, Director, National Science Foundation, USA

Dr Sethuraman Panchanathan is a computer scientist and engineer and the 15th director of the U.S. National Science Foundation (NSF). Dr Panchanathan was nominated to this position by the President of the United States in 2019 and subsequently unanimously confirmed by the U.S. Senate on June 18, 2020. NSF is an independent federal agency with annual budget of 8.5 Billion Dollars and the only government agency charged with advancing all fields of scientific discovery, technological innovation and STEM education.

Dr Panchanathan is a leader in science, engineering and education with more than three decades of experience. He has a distinguished career in both higher education and government, where he has designed and built knowledge enterprises, which advance research innovation, strategic partnerships, entrepreneurship, global development and economic growth. Dr Panchanathan previously served as the executive vice president of the Arizona State University (ASU) Knowledge Enterprise, where he was also chief research and innovation officer. He was also the founder and director of the Center for Cognitive Ubiquitous Computing at ASU. Under his leadership, ASU increased research performance fivefold, earning recognition as the fastest growing and most innovative research university in the U.S.

Prior to joining NSF, Dr Panchanathan served on the National Science Board as chair of the Committee on Strategy and as a member of the External Engagement and National Science and Engineering Policy committees. Additionally, he served on the National Advisory Council on Innovation and Entrepreneurship. He was chair of the Council on Research of the Association of Public and Land-grant Universities and co-chair of the Extreme Innovation Taskforce of the Global Federation of Competitiveness Councils. Arizona's Governor appointed Dr Panchanathan as senior advisor for science and technology in 2018. He was the editor-in-chief of the IEEE Multimedia Magazine and editor/associate editor of several international journals.

Dr Panchanathan's scientific contributions have advanced the areas of human-centered multimedia computing, haptic user interfaces, person-centered tools and ubiquitous computing technologies for enhancing the quality of life for individuals with different abilities; machine learning for multimedia applications; medical image processing; and media processor designs. He has published close to 500 articles in refereed journals and conference proceedings, and has mentored more than 150 graduate students, postdocs, research engineers and research scientists, many now occupy leading positions in academia and industry.

For his scientific contributions, Dr Panchanathan has received numerous awards, such as Distinguished Alumnus Awards and the Governor's Innovator of the Year for Academia Award for his development of information technology centric assistive and rehabilitative environments to assist individuals with visual impairments. Dr Panchanathan is a fellow of the National Academy of Inventors, where he also served as vice president for strategic initiatives. He is also a fellow of the American Association for the Advancement of Science, the Canadian Academy of Engineering, the Association for Computing Machinery, the Institute of Electrical and Electronics Engineers and the Society of Optical Engineering.

(ii) Engineers Day 2021 Celebrations by INAE on 15th September 2021

Engineers' Day is celebrated in India on September 15 every year to commemorate one of India's finest engineers, Mokshagundam Visvesvaraya. M Visvesvaraya who is considered one of the foremost nation-builders, creating marvels upon which modern India was built. INAE celebrated Engineers' Day on 15th September 2021 wherein the following event was organized.

Panel Discussion on "Closing Research-Entrepreneurship Gaps"

Dr Anil Kakodkar, Member, Atomic Energy Commission (AEC) and Chairman, Rajiv Gandhi Science & Technology Commission, Govt. of Maharashtra; Former President, INAE; delivered a Key-note Address on "Closing Research-Entrepreneurship Gaps" on September 15, 2021. Prof. Indranil Manna, President, INAE and Vice-Chancellor, Birla Institute of Technology (BIT), Mesra, Ranchi was the Moderator of the said event. The Panellists included five bright young entrepreneurs from engineering fraternity who have sparked off their journey in entrepreneurship through innovative research in engineering. The Panellists were Dr Atharva A Poundarik, Assistant Prof and Chairperson, Industrial and Corporate Relations Cell, IIT Ropar; Mr Tanuj Jhunjhunwala, Co-Founder & CEO, Planys Technologies Pvt Ltd, Bangalore; Dr Anuya A Nisal, Principal Scientist, CSIR-National Chemical Laboratory, Pune and Founder, Serigen Mediproducts; Mr Akshay V Singhal, CEO & Founder, Log9 Materials Scientific Private Ltd, Bengaluru and Mr Tushar Vyas, Director & Chief Business Officer, Stack Finance, Bengaluru.

Dr Anil Kakodkar delivered an inspiring address wherein he emphasized the need for conducting research leading to development of innovative technologies and products and setting up of start-up ventures and enterprises leading to the self-reliance of the country in niche technologies. The Panellists shared their experiences and highlighted the challenges and successes in their career paths. Prof Indranil Manna in his address lauded the work of the entrepreneurs and encouraged the younger generation to rise to the occasion by becoming entrepreneurs in engineering-based start-ups and to develop out- of the box solutions.

(iii) Panel Discussion to "Review the role of nuclear energy in managing the transition to a low-carbon electricity mix in India" on 8th December 2021

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

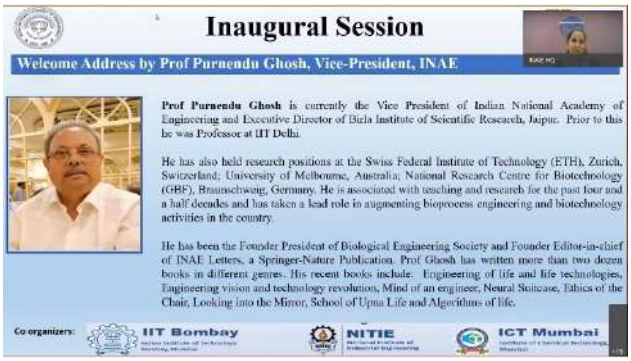
i. Dr. Anil Kakodkar, Former President INAE, AICTE Distinguished Chair Professor, Formerly Chairman, AEC & Secretary, GoI, DAE.
ii. Dr. RB Grover, Emeritus Professor, Homi Bhabha National Institute, Mumbai.
iii. Dr. Ajay Mathur, Director General, International Solar Alliance.
iv. Shri H. L. Bajaj, Former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

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

INAE Youth Activities

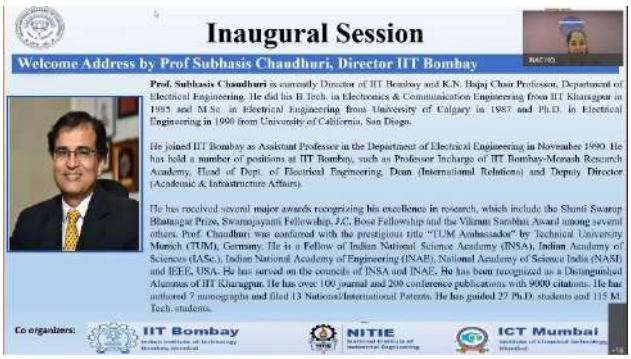
INAE Youth Conclave 2021

INAE takes great pride in shouldering the responsibility to encourage the engineering youth of the Country so as to enhance the engineering excellence, youth leadership, and encourage nation building. With a view to encourage engineering students, INAE Youth Conclaves are organized each year since 2017. The objective of the Youth Conclave is to facilitate the engagement of Indian youth in engineering activities at national level. The 4th INAE Youth Conclave 2021 was organized by INAE jointly with IIT Bombay; NITIE, Mumbai and ICT, Mumbai online for the first time on September 24, 2021, which was attended by 190 delegates including INAE Fellows, Young Associates and Engineering Students from across the country. Dr PK Goenka, Chairman-designate of INSPACe, DoS, GOI and formerly ED and Group President (Auto & Farm Sectors), Mahindra & Mahindra Ltd., Mumbai was the Chief Guest of the Inaugural Session of INAE Youth Conclave 2021. The five themes of national importance of the Conclave were Waste to wealth; Digitization and revolution in logistics; Engineering intervention to fight against COVID-19 and healthcare management; Teaching and learning in pandemic and Azadi ka Amrit Mahotsav. During the Youth Conclave competitions are held on various themes and the winners of the competition are invited to share their views through presentation and demonstration. A total of 164 teams registered in the competition and 13 were awarded after due evaluation by the experts.



Welcome Address by Prof Purnendu Ghosh

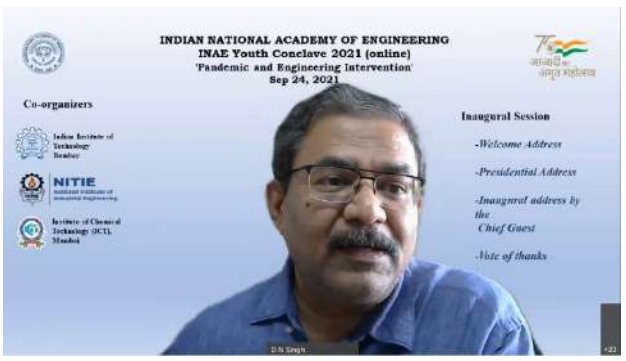
Welcome Address by Prof MK Tiwari



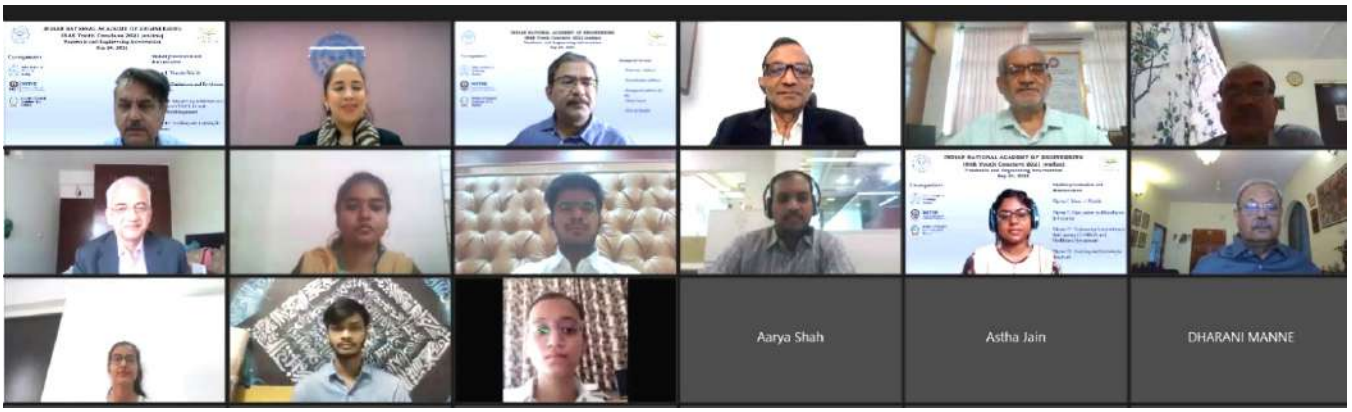
Welcome Address by Prof S Chaudhuri

Presidential Address by Prof Indranil Manna

Inaugural Address by Dr Pawan Goenka



Vote of Thanks by Prof DN Singh



Group Photograph of Delegates in Inaugural Session of INAE Youth Conclave 2021

The Inaugural Session started with the Welcome Address by Prof Purnendu Ghosh, Vice-President, INAE followed by Prof MK Tiwari, Director, NITIE, Prof Subhasis Chaudhuri, Director, IIT Bombay and Prof AB Pandit, Vice President, INAE &Vice Chancellor, ICT, Mumbai. The Presidential Address was delivered by Prof Indranil Manna, President, INAE. Then the Inaugural address was delivered by the Chief Guest, Dr Pawan Kumar Goenka followed by Vote of thanks proposed by Prof DN Singh, IIT Bombay. The talk by the Chief Guest highlighted the role of youth in making India self-reliant and scope for engineering graduates in this country to achieve success in the engineering profession. He also encouraged the youth to learn as to where the future opportunities lie and the necessary skill sets and training required for realizing opportunities. The presentations and demonstrations by 1st, 2nd and 3rd winning teams were held during the INAE Youth Conclave 2021. During the presentation, the Q&A session was also organized so as to encourage interaction of audience. The sessions were chaired by eminent INAE experts as per details give below.

i. Theme I: Waste to Wealth chaired by Mr Ajay Narayan Deshpande, Ex CMD and Director (Technical) - Engineers India Limited (EIL), New Delhi.

ii. Theme II: Digitization and Revolution in Logistics chaired by Dr RK Shyamasundar, Department of Computer Science and Engineering, IIT Bombay.

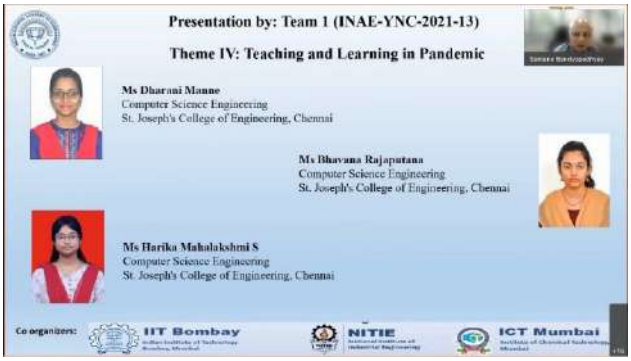
iii. Theme III: Engineering Intervention to fight against COVID-19 and Healthcare Management chaired by Dr MS Narayanan, Principal Scientist, Bioincubator, IIT Madras.

iv. Theme IV: Teaching and Learning in Pandemic chaired by Prof Santanu Bandyopadhyay, Department of Energy Science and Engineering, IIT Bombay.

Mr Ajay Narayan Deshpande, Session Chair, Theme I: Waste to Wealth,

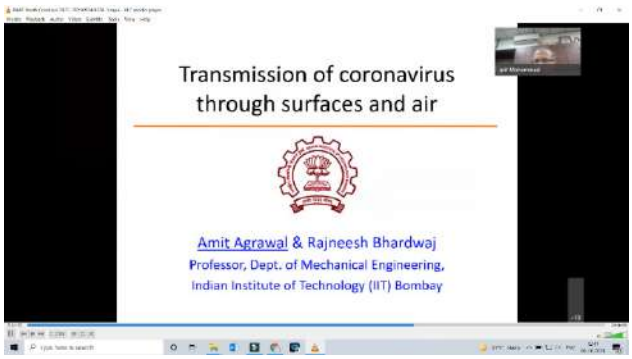
Dr RK Shyamasundar, Session Chair, Theme II: Digitization and Revolution in Logistics

Dr MS Narayanan, Session Chair, Theme III: Engineering Intervention to fight against COVID-19 and Healthcare Management

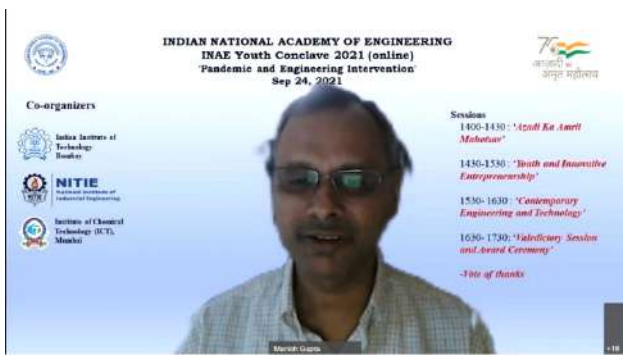


Session on Theme IV: Teaching and Learning in Pandemic Chaired by Prof Santanu Bandyopadhyay

A special session on Azadi ka Amrit Mahotsav was organized, which was chaired by Prof Amit Agrawal, Department of Mechanical Engineering, IIT Bombay. The theme was based on 'Engineering Intervention to fight against COVID-19 and Healthcare Management' and 'Innovative Technologies and Product Developed during COVID'. The students presented their concepts in the form of poster presentations. In order to inspire the students, a brief presentation on the topic "Transmission of coronavirus through surfaces and air" was also made by the Session Chair Prof Amit Agrawal which was very well received by the audience and lauded since the presentation covered important issues on a topic of concern for the world over.



Presentation by Prof Amit Agrawal, Chair, Session on Azadi ka Amrit Mahotsav



Dr Manish Gupta, Chair, Session Chair on 'Youth and Innovative Entrepreneurship'

After the five sessions, a Session on 'Youth and Innovative Entrepreneurship' was organized wherein three young Entrepreneurs presented their personal life experiences on varied topics related to Entrepreneurship. This session was chaired by Dr Manish Gupta, Director, Google Research India, Bengaluru and was very inspiring and presented insights to the young students on innovation and entrepreneurship. Next session held was a Panel Discussion on 'Contemporary Engineering and Technology' wherein four young engineers below the age of 35 years participated in the discussion. This session was appreciated by young and old alike and featured deliberations by the Panelists comprising of the young engineers and future leaders of tomorrow namely: Dr Neha Khatri, Senior Scientist, CSIR-CSIO, Chandigarh; Dr Abir De, Assistant Professor, IIT Bombay; Mr Pankaj Malhotra, Scientist, TCS, Mumbai and Mr Sri Harsha Nistala, Scientist, TCS, Pune. The Panel Discussion was chaired by Mr K Ananth Krishnan, Executive Vice- President and Chief Technology Officer, TCS, Chennai. During this session, interesting issues of topical engineering interest shall be discussed such as "What are the mega challenges of today for India and the world", covering Sustainability and its dimensions like climate, energy, livelihood, health and "How can Engineering and Technology help in finding solutions", touching upon the intersection with Basic Sciences and Humanities, translating ideas to scaled outcomes and creating the human capital. Further the discussion also focussed on the suggestions from the panelists to the young audience, as they build their careers in contemporary engineering and technology.

Mr K Ananth Krishnan, Chair, Panel Discussion on *'Contemporary Engineering and Technology'*

Concluding Address by Prof AB Pandit

The event concluded with valedictory Session and Award ceremony followed by concluding Address by Prof AB Pandit, Vice President, INAE. During the Award ceremony the Awards and the names of the winning teams were announced by Prof DN Singh and his team at IIT Bombay. Prof Indranil Manna, President, INAE congratulated all the winners and also expressed appreciation for all participants who put in their best efforts and wish all many more accolades in their future career paths. The event concluded with Vote of Thanks proposed by Prof DN Singh, IIT Bombay, Organizer of the INAE Youth Conclave 2021. The gala online event set the trend for future Youth Conclaves being organized by INAE and was distinctive in being the first Youth Conclave organized online with a large audience and interesting interactive sessions which made the event unforgettable for all delegates and participants.

Abdul Kalam Technology Innovation National Fellowship

The Abdul Kalam Technology Innovation National Fellowship is an initiative as one of the outcomes of the meetings of the DST-INAE Consultative Committee. INAE and Science and Engineering Research Board (SERB), Department of Science and Technology (DST) had jointly launched the INAE-SERB, DST Abdul Kalam Technology Innovation National Fellowship in the year 2017 to recognize, encourage and support translational research by Individuals working in various capacities of engineering profession, in public funded institutions in the country. The duration of the fellowship will be initially for three years, extendable by up to two more years depending on the performance. The fellowship can be held for a maximum of 5 years. The cut-off date of receipt of nominations for this Financial Year is June 30, 2022. For more details, please visit INAE website https://www.inae.in/research-innovation/abdul-kalam-technology-innovation-national-fellowship-2019-20/

As per the guidelines, the nominees for the subject Fellowship should have a minimum of 5 years' service left in the parent organization. A financial support of up to Rs 19 lakhs per annum is given to the selected fellows towards research grant, honorarium and overhead expenses. 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. The nominations are accepted throughout the year. A nominee who had applied in previous Financial Years and not selected is eligible to apply again, provided the nominee has a residual service of five years left in his/her parent organization. The nominations received are evaluated by high level Search Cum Selection Expert Committee (SSEC).

A maximum of up to 10 Fellowships can be awarded in a year. The duration of the Fellowship is initially conferred for a period of three years. On completion of three years the fellowship is being reviewed and if the progress is found to be in line with the proposal, an extension of additional two years is being granted to the fellow. Accordingly, the Fellowship can be held for a maximum of 5 years. So far, total of 37 fellowships have been conferred so far and 10 fellows have been granted extension of tenure. Six Fellowships were conferred during the Financial Year 2017- 18, eight during the Financial Year 2018-19, seven during the Financial Year 2019-20, six during the Financial Year 2020-21 and ten nominees were selected during the Financial Year 2021-22.

Ten nominees selected during year 2021-22:

1. **Prof Hiralal Murlidhar Suryawanshi, Director, NIT Hamirpur,** conferred for his proposal on "Solid State Transformer Technology for Emerging Trends in Electric Mobility and DC Micro-Grid" during the Search Cum Selection Expert Committee meeting held on August 6, 2021. The tenure of his fellowship was initially conferred for the period of three years with effect from October 1, 2021 i.e. from October 1, 2021 to September 30, 2024.

2. **Dr K.C. James Raju, Centre for Advanced Studies in Electronics Science & Technology (CASEST), School of Physics, University of Hyderabad,** conferred for his proposal on "Development of integrated miniature magnet free microwave circulator" during the Search Cum Selection Expert Committee meeting held on August 6, 2021. The tenure of his fellowship was initially conferred for the period of three years with effect from October 1, 2021 i.e. from October 1, 2021 to September 30, 2024.

3. **Dr Deepa Venkitesh, Indian Institute of Technology Madras,** conferred for her proposal on "Nyquist Photonic Analog to Digital Converter for instantaneous frequency measurement" during the Search Cum Selection Expert Committee meeting held on August 6, 2021. The tenure of her fellowship was initially conferred for the period of three years with effect from October 1, 2021 i.e. from October 1, 2021 to September 30, 2024.

4. **Dr Mayank Shrivastava, Associate Professor, Department of Electronic Systems Engineering Indian Institute of Science, Bangalore,** conferred for his proposal on "Development of Gallium Nitride (GaN) Based

Technology Platform for THz Applications" during the Search Cum Selection Expert Committee meeting held on August 6, 2021. The tenure of his fellowship was initially conferred for the period of three years with effect from October 1, 2021 i.e. from October 1, 2021 to September 30, 2024.

5. **Prof Swades De, Department of Electrical Engineering Indian Institute of Technology Delhi,** conferred for his proposal on "Green/Sustainable IoT for Smart Environment" during the Search Cum Selection Expert Committee meeting held on August 6, 2021. The tenure of his fellowship was initially conferred for the period of three years with effect from October 1, 2021 i.e. from October 1, 2021 to September 30, 2024.

6. **Prof Pramod Kumar, Associate Professor, Department of Mechanical Engineering Indian Institute of Science, Bangalore,** conferred for his proposal on "Standalone kilowatt scale sCO_2 power blocks for Concentrated Solar Thermal Power Generation" during the Search Cum Selection Expert Committee meeting held on August 6, 2021. The tenure of his fellowship was initially conferred for the period of three years with effect from October 1, 2021 i.e. from October 1, 2021 to September 30, 2024.

7. **Dr Dibakar Sen, Indian Institute of Science, Bangalore,** conferred for his proposal on "Smart Prosthetic Arm" during the Search Cum Selection Expert Committee meeting held on August 6, 2021. The tenure of his fellowship was initially conferred for the period of three years with effect from October 1, 2021 i.e. from October 1, 2021 to September 30, 2024.

8. **Prof P. Muthukumar, Department of Mechanical Engineering, Indian Institute of Technology Guwahati,** conferred for his proposal on "Design, Development, Testing and Commercialization of Porous Radiant Burners for Domestic Cooking and Industrial Applications" during the Search Cum Selection Expert Committee meeting held on August 6, 2021. The tenure of his fellowship was initially conferred for the period of three years with effect from October 1, 2021 i.e. from October 1, 2021 to September 30, 2024.

9. **Prof Vandana B. Patravale, Department of Pharmaceutical Sciences and Technology, Institute of Chemical Technology, Mumbai,** conferred for her proposal on "Development of drug-eluting coatings for self-expandable peripheral stent for the treatment of in-stent restenosis" during the Search Cum Selection Expert Committee meeting held on August 6, 2021. The tenure of his fellowship was initially conferred for the period of three years with effect from October 1, 2021 i.e. from October 1, 2021 to September 30, 2024.

10. **Dr Jyotsnendu Giri, Associate Professor, Department of Biomedical Engineering Indian Institute of Technology Hyderabad,** conferred for his proposal on "Autologous Platelet-rich Plasma (PRP) Loaded Personalized Wound Care Patch at Patient Bedside for Effective Burn Wound Care" during the Search Cum Selection Expert Committee meeting held on August 6, 2021. The tenure of his fellowship was initially conferred for the period of three years with effect from October 1, 2021 i.e. from October 1, 2021 to September 30, 2024.

The fellowship has been receiving good response and is progressing well over the years. Number of nominations being received every year has been increasing. The executive summary and media report in respect of selected nominees for Abdul Kalam Technology Innovation National Fellowship can be viewed at INAE website www.inae.in

Reaching out to Policy Makers: Interaction with Government Agencies

DST-INAE Consultative Committee

During one of the DST-INAE Consultative Committee meetings held earlier, Prof Ashutosh Sharma, Secretary, DST had confirmed allocation of office space to INAE within DST complex. Accordingly, INAE was provided an office space at the DST Complex, Technology Bhawan, New Delhi. INAE office had since been operational from the DST Complex from August 2, 2021 onwards. The new office of INAE at DST Complex was formally inaugurated on August 25, 2021 by Prof Ashutosh Sharma, the then Secretary, DST on the side-lines of the DST-INAE Consultative Committee meeting held on the same day. The following members were present:

- Prof Ashutosh Sharma, Secretary, DST
- Prof Indranil Manna, President, INAE
- Dr Sanak Mishra, Immediate Past President, INAE
- Dr BN Suresh, former President, INAE
- Dr PS Goel, former President, INAE
- Dr Purnendu Ghosh, Vice-President, INAE
- Prof AB Pandit, Vice-President, INAE - attended online on WebEx
- Prof Sivaji Chakravorti, Vice-President, INAE
- Mr Sunil Kumar, Joint Secretary, AI Cell, DST
- Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE

During the said meeting several points were discussed to include various technical activities in association of women engineers, startups and engineering institutions with activities of INAE.

CSIR-INAE Consultative Committee

CSIR-INAE Consultative Committee had been constituted in the year 2020. The objective of Consultative Committees is to discuss and decide on areas of mutual interest of both organizations so as to align the activities undertaken by INAE with the thrust areas of national importance. A meeting of the CSIR-INAE Consultative Committee was held online on December 9, 2021. During the meeting discussions were held regarding the involvement of INAE with CSIR's "Hydrogen Energy Mission Programme" which has been launched by CSIR with the aim of Hydrogen Energy Vector to play a major role for India becoming "Atmanirbhar Bharat" in the area of Clean Energy. The meeting was attended by the members of the CSIR-INAE Consultative Committee who discussed the way forward regarding the suggested role of INAE in this mission programme.

Research Schemes

The INAE Chair Professorship and INAE Distinguished Professors/Technologists schemes were put on hold from the year 2020 onwards to review and improve the effectiveness and outreach of the subject schemes. After deliberations, the Guidelines of the above-mentioned schemes were revised by the INAE Governing Council to be effective from the year 2022 onwards and the schemes were reinstated.

INAE Chair Professorship

INAE Chair Professorship was instituted in order to encourage engineers/technologists with outstanding research contributions, promote long-term participation in academic research and enhance the research standards in academic institutions. Nominations for the year 2022 were invited and the last date for receipt of nominations was February 9, 2022. The following nominees were conferred the INAE Chair Professorship.

1. Prof DV Khakhar, Department of Chemical Engineering, IIT Bombay

2. Prof Samit Kumar Ray, Department of Physics, IIT Kharagpur

INAE Distinguished Professors/Technologists

The objective of this Scheme is to utilize the expertise of INAE Fellows after superannuation and those not in regular employment primarily for research in Institutions/ Universities/ Research & Development establishments, and industry in India. The Fellows may choose any institution of their choice which may be the same institution from where superannuated. Nominations for the year 2022 were invited and last date of receipt of nominations was February 9, 2022. The following nominees were conferred as INAE Distinguished Professors/ Technologists

(i) Prof K Bhanu Sankara Rao (Tenure: 1 Year), IIT Hyderabad

(ii) Prof Hari Hablani, IIT Indore

(iii) Prof Kripa Shanker, IIT BHU, Varanasi

(iv) Prof RK Shyamasundar, IIT Bombay

Mentoring of Engineering Teachers by INAE Fellows/ INAE Young Associates

INAE undertakes mentoring of Engineering Teachers from recognized Engineering institutions with a view to enhance the quality of Engineering education being imparted in the country. In this year 2022, besides the existing format of INAE Fellows nominating pre-identified engineering teachers (mentees), the process was made available to other mentees online through INAE Digital Platform, so that engineering teachers who have no access to esteemed Fellows of INAE be made aware of willing mentors at INAE to benefit from the scheme. In addition to above, Young Associates (YA) who have completed 5 years as a Young Associate and are in regular employment are now eligible to mentor one Engineering Teacher.

A total of seven Engineering Teachers were selected under scheme on "Mentoring of Engineering Teachers by INAE Fellows" this year, as per details given below.

S No	Name of the Mentor	Organisation/ Institute of the Mentor	Teacher Name	Designation	Teacher Institution
1	Prof Radhakant Padhi	Indian Institute of Science, Bangalore	Mr Ramprasadh C	Professor	SASTRA Deemed to be University, Tirumalaisamudram
2	Prof Radhakant Padhi	Indian Institute of Science, Bangalore	Dr IT Arasu	Associate Professor	Manipal Institute of Technology
3	Prof Vegensna Satyanarayana Raju	Prof V S Raju Consultants, Gachibowli, Hyderabad	Ms Jahnavi Thentu	Assistant Professor	Gokharaju Rangaraju Institute of Engineering and Technology, Hyderabad
4	Prof Sudip Misra	Indian Institute of Technology Kharagpur	Dr Babul Prasad Tewari	Assistant Professor	Indian Institute of Information Technology, Bhagalpur
5	Prof Sudip Misra	Indian Institute of Technology Kharagpur	Dr Nitin Gupta	Assistant Professor	National Institute of Technology Hamirpur
6	Prof Suman Chakraborty	Indian Institute of Technology Kharagpur	Dr Ravi Kant	Assistant Professor	Pandit Deendayal Energy University, Gandhinagar, Gujarat
7	Dr Prahlada Ramarao	Pro Chancellor S-VYASA University, Bengaluru	Dr Sankarshan B. M.	Assistant Professor	The National Institute of Engineering, Mysuru

Mentoring of Engineering Students by INAE Fellows/ Young Associates

INAE undertakes mentoring of meritorious 3rd /4th year B.E./B.Tech/BSc. (Engg.) students from recognized Engineering institutions, for two months during the academic year, with a view to provide them guidance so as to excel further in their field of study and improve the quality of engineering education. Applications for mentoring of Engineering Students were invited for the year 2022. The last date to submit the Application form by the mentee was February 6, 2022. The last date to evaluate the Applications received by the mentor and submit to INAE was February 13, 2022.

In this year, 2022 besides the existing format of INAE Fellows nominating pre-identified mentees (engineering students); in the year 2022, the process was made available to other mentees online through INAE Digital Platform, so that engineering students who have no access to esteemed Fellows of INAE be made aware of willing mentors at INAE to benefit from this scheme. In addition to above, Young Associates (YA) who have completed 5 years as a Young Associate and are in regular employment are now eligible to mentor one Student.

A total of thirty Engineering Students were selected under scheme on "Mentoring of Engineering Teachers by INAE Fellows" this year, as per details given below.

S No	Mentor Name	Organisation/ Institute of the Mentor	Student Name	Student Institution
1	Dr Chennu Ranganayakulu	BITS Pilani, Rajasthan	Mr Rohan Ramesh Balkondekar	Shri Guru Gobind Singhji Institute of Engineering and Technology, Nanded
2	Dr Chennu Ranganayakulu	BITS Pilani, Rajasthan	Mr Rahul P	Kumaraguru College of Technology
3	Dr J. Krishnan	M.S. University of Baroda	Ms Falak Patel	Pandit Deendayal Energy University, Gandhinagar
4	Dr Lipika Dey	IIT Delhi	Ms Dhvani Gupta	Model Institute of Engineering and Technology, Jammu
5	Dr Parag Ratnakar Gogate	Institute of Chemical Technology (ICT), Mumbai	Ms Reshma B	Sri Sivasubramaniya Nadar College of Engineering
6	Dr R Balasubramaniam	Bhabha Atomic Research Centre, Mumbai	Mr Suyash Yadav	Vellore Institute of Technology, Vellore
7	Dr R Balasubramaniam	Bhabha Atomic Research Centre, Mumbai	Mr Suryansham Tiwari	National Institute of Technology Agartala
8	Dr Reddy GV Prasad	Indira Gandhi Centre for Atomic Research, Kalpakkam	Mr Karthick Raja P	PSG College of Technology
9	Dr SVS Narayana Murty	Liquid Propulsion Systems Centre, Trivandrum	Mr Abhijeet Singh	IIT Patna
10	Dr SVS Narayana Murty	Liquid Propulsion Systems Centre, Trivandrum	Ms Geetika Racherla	IIT Roorkee
11	Dr VR Lalithambika	Former Distinguished Scientist, ISRO	Ms Nehi Sinha	Manipal Institute of Technology
12	Prof Benjaram Mahipal Reddy	Birla Institute of Technology & Science (BITS), Pilani	Mr Siddharth Sonti	Institute of Chemical Technology, Mumbai
13	Prof Bidyut Baran Chaudhuri	Indian Statistical Institute, Kolkata	Mr Ankur Deria	Jalpaiguri Government Engineering College
14	Prof Bijoy Bhattacharyya	Jadavpur University, Kolkata	Ms Madhumitta P	Kumaraguru College of Technology
15	Prof Dipanwita Roy Chowdhury	Indian Institute of Technology, Kharagpur	Mr Sauradip Sengupta	Kalinga Institute of Industrial Technology
16	Prof Dipti Ranjan Sahoo	Indian Institute of Technology Delhi	Mr Rangaraj B	PSG College of Technology

17	Prof Himadri Sekhar Maiti	Govt. College of Engineering and Ceramic Technology, Kolkata	Mr Souradeepta Ganguly	Jadavpur University
18	Prof Nandita Dasgupta	IIT Madras	Mr Dweepayan Biswal	Odisha University of Technology and Research
19	Prof Radhakant Padhi	Indian Institute of Science, Bangalore	Mr Rohit S	Anna university-MIT Campus
20	Prof Sumantra Mandal	IIT Kharagpur	Ms Urbee Roy	Jadavpur University
21	Prof Rahul Mitra	Indian Institute of Technology Kharagpur	Mr Aishik Saha	Jadavpur University
22	Prof Sanjay Mittal	Indian Institute of Technology Kanpur	Mr Pearl Christabel Thomas	National Institute of Technology Calicut
23	Prof Sudip Misra	IIT Kharagpur	Mr Dattatraya Biswal	College of Engineering and Technology, Bhubaneswar
24	Prof Suman Chakraborty	IIT Kharagpur	Mr Mainak Adak	National Institute of Technology, Tiruchirappalli
25	Prof Suman Chakraborty	IIT Kharagpur	Mr Soham Biswas	Jadavpur University
26	Prof Sushmita Mitra	Indian Statistical Institute, Kolkata	Mr Hithesh Lade	BITS Pilani
27	Prof Sushmita Mitra	Indian Statistical Institute, Kolkata	Mr Sai Aakash R	Sri Sivasubramaniya Nadar College of Engineering, Chennai
28	Dr R Gopalan	International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Chennai	Ms Tallapu Surya Kumari	RGUKT-Nuzvid, Mylavaram Road
29	Dr R Gopalan	International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Chennai	Ms Mamidi Lijita Sree	NIT, Andhra Pradesh
30	Prof HS Kushwaha	Bhabha Atomic Research Centre, Mumbai	Ms Nidhi Prasad	BIT Mesra

INAE Expert Groups

INAE Expert Groups had been instituted in year 2020 to develop a comprehensive engineering/technology road map with clear actionable recommendations on selected engineering themes or domains so that INAE can assist the policymakers to work out a strategy and/or arrive at a policy, based on recommendations, followed by its implementation which will have the desired impact. INAE invites proposal for INAE Expert Groups from INAE Fellowship which are evaluated by the Steering Committee and further recommended for approval by INAE Governing Council. The following Expert Groups are in force till date:

- INAE Expert Group on "Industrial By-products (IBPs) for Sustainable Infrastructure Development" with Prof. DN Singh, IIT Bombay, as the Principal Investigator.

- INAE Expert Group on "Infrastructure and Resource Requirements for Introduction of Automation and its Adoption in the Mineral Sector of India: A Stakeholder Engagement" with Prof. Jayanta Bhattacharya, IIT Kharagpur, as the Principal Investigator.

- INAE Expert Group on "Accelerated Materials Discovery, Scale-up and Exploitation Strategy for Strategic Materials Needs of India" with Dr. Biswajit Basu, Former Dy. CTO & Head, Aditya Birla Science & Tech Co. Pvt. Ltd, as the Principal Investigator.

- INAE Expert Group on "Advanced Microwave- Terahertz wave Technology & Applications- Way ahead for India" with Dr Lalit Kumar, Ex-Chairman, CEPTAM, Ex-Director, MTRDC-DRDO, Bangalore, as the Principal Investigator.

- INAE Expert Group on "Technology roadmap for capture and conversion (CCUS) of CO_2 to value added chemicals" with Prof K. K. Pant, IIT Delhi, as the Principal Investigator

INAE Forums

One of the important objectives of the Academy is to assist the Government from time to time in formulating policies on critical technical issues. For this purpose, five forums have been constituted – INAE Forum on Energy, INAE Forum on Technology, Foresight and Management, INAE Forum on Engineering Interventions for Disaster Mitigation, INAE Forum on Indian Landscape of Advanced Structural Materials and INAE Forum on Civil Infrastructure. These forums enable giving inputs to policy makers, institutes of higher learning & research, industries, etc.

INAE Forum on "Civil Infrastructure"

The forum was formed to address the subject area of INFRASTRUCTURE, to cover specifically the issues of Traffic & Transportation, Housing and Water. The main objective of the forum is to create reports from its study to recommend needed actions, related to, Policy Initiatives, Engineering Development/Research, Education, and, so on, and, suggesting the Way Forward. As mentioned in the report for the previous year, a report entitled, "URBAN TRANSPORTATION: Challenges and Way Forward" based on the study, was released at the Annual Convention of the INAE at Jaipur in December 2019. Further, a study had been initiated, as mentioned in the annual report of the previous, to address the subject of Housing in India. The major part of the work for the study was completed in the same year.

After the report on the study reached a pre-final stage, an Extended Executive Summary was shared in September/ October 2021, with stakeholders from amongst academia, practice and the INAE Fellowship, seeking their suggestions/comments for improvements in the report. Generally, the report was appreciated. This exercise was extended by organising an Online Discussion Meeting, wherein the salient features of the report were presented and discussed with a select group of stakeholders having close association with the subject of Housing. The purpose of the exercise was to solicit from the select gathering any further ideas/points for improving and finalising the report. The meeting was held from 14.30 hrs to 16.00 hrs. on Friday 09 December 2021. Shri Durga Shenkar Mishra, Secretary to the GOI, MHoUA, had kindly agreed to be the Guest Speaker at the meeting.

Taking into account the takeaways from the above-mentioned efforts the script has been finalised, and, the script is ready for printing in June 2022.

Discussion Meeting Online
09 December, 2021. 12 noon – 13.30 hrs

Welcome	Lt. Col. (Retd.) Shobhit Rai (Retd), Deputy Executive Director INAE
About the Study on Housing	Professor Prem Krishna, Chairman, INAE Forum on Civil Infrastructure
The Housing Scenario in India	Professor P K Sikdar, FNAE
Emerging Technologies for Mass Housing	Dr. S K Agarwal, Executive Director, BMTPC, (Buildings Materials and Technology Promotion Council)
Impediments & Way Forward	Prof. N. Raghavan, FNAE
Invited Address	Shri Durga Shankar Mishra, Secretary MH&UA
Presidential Remarks	Professor Indranil Manna, President, INAE
Discussion	*Moderators:* Prof. S. K Bhattachharyya, FNAE Dr. Mangu Singh, FNAE
Conclusion of Proceedings	Professor Mahesh Tandon, FNAE

INAE Forum on Engineering Interventions for Disaster Mitigation

The Forum transited into the period under the Report from 1 April 2021 to 31 March 2022 with its major thrust on the pursuit of the INAE Project on Valorization of Industrial Waste. Its progress was presented by Prof DN Singh, the Chairman of the Forum (the Project Coordinator) in the Forum's meeting held on 16th April 2022. The initiative to launch this project was the outcome of the Forum's Roundtable meeting held on 20th March 2020 during which the multi-faceted aspects of Vaporization of Industrial Wastes for Hazard Mitigation for sustainable development were discussed in detail. Apropos the INAE approval of the project in May 2020, the nation-wide consultations began, a strategy for project implementation was formulated, attempts were made to access credible data sources, and to intensify the deliberations, aiming at a set of Actionable Recommendations based on a thorough data analysis. The project report for the two modules (Steel Slags and Red Mud) is being reviewed by the experts and would be finalised very soon.

Contributions were made by the Forum through a decade long sustained engagement with the related government agencies, knowledge institutions and other stake holders chiefly through roundtable meetings, monographs, thematic papers and keynote lectures with a focus on the national concerns relating to disaster risk resilience. Effort continues, and needs to be intensified by the Forum, especially to address challenges posed by factors such as Non-engineered constructions, Climate Change and Rapid pace of national development, viewed from a multi-hazard perspective. Many of the Forum's recommendations, made from time to time, are already under the various stages of implementation, but some of these do require sustained follow-up.

A comprehensive Report and a PowerPoint presentation were prepared highlighting the contributions made by the Forum since its inception in 2013. These were discussed at the Forum meeting held in April 2022, from the present and the future perspectives. The discussion, inter alia, included Forum's response to the national call for documentation of the Best Practice examples, and Lessons from Disasters. The evolving agenda for the newly constituted Forum holds promise to add many more best practice examples in the coming years.

The items of unfinished agenda handed over to the newly constituted Forum include (1) A in-depth discussion on the INAE White Paper on Technological Preparedness to face National Disruptions and follow-up Action (2) Finalization of the Report on Valorization of Industrial Waste (3) World Class Multi-Hazard Resilient Infrastructure and (4) Inter-linking of Rivers. The ongoing discussion on implementation of the Sendai Framework for Disaster Risk Reduction (2015- 2030); implementation the recommendations on Disaster Mitigation Fund made by the FC-XV covering five fiscal years, from 1 April 2020 to 31 March 2025 and the challenges flagged by the Consortium for Disaster Resilient Infrastructure (CDRI) launched by the PM at the UN Climate Summit should continue.

INAE Forum on Indian Landscape of Advanced Structural Materials

The INAE Forum on Indian Landscape of Advanced Structural Materials was created to review the current status of availability, quality and adequacy of structural (load bearing) materials in India and outline the gap and challenges to be overcome to meet the current and futuristic demands in construction, strategic, aerospace, automobile, energy and all other important sectors. The challenges lie not just in raw material, equipment and competence, but also in creation of demand and sustenance of interest and business. Therefore, the task is absolutely essential if India truly means to be Atma Nirbhar. The INAE Forum on Indian Landscape of Advanced Structural Materials is publishing special volume with very well researched articles addressing specific thematic areas authored by the most eminent engineers and technologists of the country. It is envisaged that the articles will provide a ready reference to the planners, researchers, entrepreneurs and industry-leaders both from civilian and strategic sectors in the country for developing advanced structural materials encompassing metals and alloys, ceramics, polymers, composites and hybrids that will make India both self-reliant and technologically advanced. The book on "Future Landscape of Structural Materials in India" prepared by the INAE Forum on Indian Landscape of Advanced Structural Materials is under printing.

INAE Forum on Energy

The INAE Forum on Energy undertook important activities during the year. The most important being involvement with the Engineers' Conclave 2021 held on 26-27 October 2021. The Theme-1 was 'Engineering Challenges for Decarbonizing the Indian Economy' under the chairmanship of Dr. Ajay Mathur. This theme session was conducted in three technical sessions and two preliminary talks. These sessions were as follows:

Technical Session-1: Energy Transition – Integrating RE Technologies in the Electricity Sector

Technical Session-2: E-Mobility Solutions for the Transport Sector

Technical Session-3: De-carbonizing Heavy Industries

Distinguished addresses

Prof. K. Vijayraghavan, PSA, GOI delivered a distinguished address (through video recording) on E-Mobility Solutions for the Transport Sector.

Lord Adair Turner, Chair, Energy Transitions Commission, delivered the keynote address. He presented a global scenario to limit 1.5 degree rise in temperature and net zero by 2050.

Recommendations

1. In its move to net zero by 2070 (as announced by the Hon'ble PM at COP26, Glasgow, though in the Conclave the year mentioned was 2050) India needs to transform to a non-fossil fuel economy. This requires utilization of cleaner coal technologies, nuclear power and batteries.

2. Directed technology research and development starting now is essential to meet the goals of the energy transition.

3. The electricity sector transition to renewable sources requires major re-orientation in grid management by the system operator from the national level to the distribution company level.

4. The transport sector requires interventions to enable a move towards the use of battery power, hydrogen, and renewable-based electricity.

5. In the industrial sector, most low temperature applications can be converted to electric heating, powered by renewable electricity. For higher temperature applications, hydrogen fuels, produced by the splitting of water using green electricity, could be a possible solution.

6. Energy transition calls for industry benchmarking, efficiency improvement and large renewable applications. Short-term measures are as important as long-term measures. Recycling is an important immediate measure.

7. Government needs to focus on various issues that can broadly be categorized as: (i) Physical Building Blocks; (ii) Economic and Societal Adjustment; (iii) Governance, Institutions and Commitment.

8. Innovation and technology development will include an important component of technology demonstration and assimilation. Both have long gestation periods, which should be appropriately factored in technology deployment.

9. For all non-fossil fuel applications, capital cost predominates (since there are very low operating costs). Consequently, it is important to bring down the cost of capital.

The above-mentioned actionable recommendations emanated from the deliberations of Engineers Conclave 2021 are being followed-up with the concerned Government Departments/agencies for consideration.

INAE Forum on "Technology Foresight and Management for Addressing National Challenges"

INAE Forum on Technology Foresight and Management for addressing National Challenges was constituted in the year 2012. The mandate of the Forum was to evolve solutions keeping in view the issues of sustainable development, poverty reduction, and climate change in focus and suggest appropriate technologies accordingly. This Forum was chaired by Late Mr VK Agarwal, FNAE & Formerly Chairman, Railway Board since 2012. The First Report of the Forum was published in 2014 which covered the areas pertaining to Waste Management, Water – Meeting the Future Challenges, and Transport – Making it Greener. The Second Report of the Forum was published during 2016 which covered the aspects of Agriculture – Waste Reduction and its use; Energy – Major Thrust on Solar; and Mass Transit Systems. The Third Report of the Forum was published in 2018 which addressed pertinent issues and concerns regarding Rural Urban Continuum and Development of High-Speed Rail in the country. The Fourth Report covering three broad areas viz. (a) Issues of Environment / Climate Change / Sustainability (b) Rail-based Infrastructure Urgently Needs Four Major Interventions at the Level of Government of India (c) Improving the Operating Ratio of Indian Railways – A Way Forward.

Due to sudden demise of Mr VK Agarwal, the INAE fellows who were members of this Forum had a virtual meeting on March 9, 2022 to discuss the way forward. The next phase of the Forum is likely to be instituted shortly.

INAE "Satish Dhawan Chair(s) of Engineering Eminence"

INAE Satish Dhawan Chair of Engineering Eminence was instituted with the objective of enhancing the visibility of the Academy in the policy domain and establishing social connect. Eminent engineers who have contributed to some aspect of nation building are chosen for this esteemed position. The objective of the Chair is to utilize their competence to facilitate future growth of the nation in the engineering domain. Dr BN Suresh, Former President of INAE; Chancellor, Indian Institute of Space Science & Technology (IIST) and Honorary Distinguished Professor, ISRO Headquarters, Bangalore and Formerly Director, Vikram Sarabhai Space Centre, Trivandrum; and Formerly Member, Space Commission and Founder Director, Indian Institute of Space Science & Technology (IIST), Thiruvananthapuram had been chosen for holding Satish Dhawan Chair of Engineering Eminence for the year 2021, extendable up to one more year. He was associated with ISRO HQ for institutional support for carrying out the work under the aegis of the Chair. Dr BN Suresh had chosen the topic of "Contribution of Space for National Development and the Possible Future Areas to improve the Indian Economy", to work under the ambit of this Chair. The task entailed consolidating the utilisation of space technology-based tools so far in Governance and national development, which has made significant contributions in several areas of agriculture, energy, environment, forestry, water resources, communication and navigation, health, education, disaster management and many other areas. Further the report will include the possible areas of new applications of space for accelerating the national development thus contributing to the growth of the National Economy.

Dr BN Suresh commenced the work under the aegis of the subject chair w.e.f. January 1, 2021 at ISRO HQ, Bangalore and had been working on creating a compilation of articles and chapters on various space related applications including satellites, remote sensing for agriculture and aerial mapping etc under the aegis of the subject Chair. The Governing Council during its meeting on December 7, 2021 recommended the grant of extension of tenure of Dr BN Suresh for one more year as Satish Dhawan Chair of Engineering Eminence i.e., from January 1, 2022 to December 31, 2022, to complete the task at hand.

Engineering Excellence Awards

Life Time Contribution Award in Engineering 2021

This award is given to an eminent Indian citizen who has made most distinguished contributions in the field of Engineering / Engineering Research / Technology, which have brought prestige to the nation and regarded as landmarks of technological development of the country.

During the year 2021, the Life Time Contribution Award in Engineering was conferred on:

Mr Senapathy "Kris" Gopalakrishnan, Co-founder Infosys & Chairman Axilor Ventures was conferred the award virtually in recognition of his outstanding contributions to the growth of Information Technology industry, as a supporter of world class research, innovation, and entrepreneurship in the country.

Prof MS Ananth, Emeritus Research Fellow, Department of Chemical Engineering, IIT Madras; and Former Director, Indian Institute of Technology Madras was conferred the award virtually in recognition of his outstanding contributions as an institution builder and academician and seminal contributions to the growth of engineering education in the country.

Prof. Jai Krishna and Prof. SN Mitra Memorial Award 2021

These awards are given to an eminent engineer, engineer-scientist, or a technologist for one or more of the following:

(a) Academic and scholarly achievements in any discipline of technology

(b) Outstanding research in engineering and technology and application thereof.

(c) Outstanding contributions in the management of education and research in engineering

(d) Outstanding achievements and contributions in the Indian industry, engineering services or engineering projects

Prof Jai Krishna Memorial Award is given from among the disciplines of Engineering Section I (Civil Engineering), Engineering Section III (Mechanical Engineering), Engineering Section IV (Chemical Engineering), Engineering Section VII (Aerospace Engineering) and Engineering Section VIII (Mining, Metallurgical and Materials Engineering).

Prof S N Mitra Memorial Award is given from among the disciplines of Engineering Section II (Computer Engineering and Information Technology), Engineering Section V (Electrical Engineering), Engineering Section VI (Electronics & Communication Engineering), Engineering Section IX (Energy Engineering) and Engineering Section X (Interdisciplinary and Special Engineering Fields and Leadership in Academia, R&D and Industry)

During the year 2021, Prof Jai Krishna and Professor SN Mitral Memorial Awards were conferred on:

Prof Jai Krishna Memorial Awardee

Prof GD Yadav, Emeritus Professor of Eminence and JC Bose National Fellow, Former Vice Chancellor & R.T. Mody Distinguished Professor, and Tata Chemicals Darbari Seth Distinguished Professor of Leadership and Innovation, Institute of Chemical Technology, Mumbai was conferred virtually the Prof Jai Krishna Memorial Award 2021 in recognition of his outstanding multifarious research contributions in the fields of Green Chemistry and Engineering, Catalysis, Chemical Engineering, Energy Engineering, Biotechnology, Nanotechnology, and Development of Clean and Green Technologies.

Professor SN Mitra Memorial Awardee

Prof Surendra Prasad, Department of Electrical Engineering, Indian Institute of Technology Delhi and Former Director, IIT Delhi was conferred virtually the Prof SN Mitra Memorial Award 2021 in recognition of his outstanding contributions in the field of Engineering, especially as a teacher, mentor, researcher, academic administrator and accreditor.

INAE Outstanding Teachers Award 2021

The Academy has instituted the "Outstanding Engineering Teachers Award" in the year 2013 to honour INAE Fellows who have excelled in the field of teaching in Indian colleges, universities, and institutions, and have provided guidance and inspired students to take up careers in Engineering and Technology. Two such awards are given per year with one award in each group as under.

Group-1 - covering Engineering Section I (Civil Engineering), Engineering Section III (Mechanical Engineering), Engineering Section IV (Chemical Engineering), Engineering Section VII (Aerospace Engineering) and Engineering Section VIII (Mining, Metallurgical and Materials Engineering).

Group-2 - covering Engineering Section II (Computer Engineering and Information Technology), Engineering Section V (Electrical Engineering), Engineering Section VI (Electronics & Communication Engineering), Engineering Section IX (Energy Engineering) and Engineering Section X (Interdisciplinary and Special Engineering Fields and Leadership in Academia, R&D and Industry).

During the year 2021, INAE Outstanding Teachers Award was conferred on:

Prof Suman Chakraborty, Department of Mechanical Engineering, Indian Institute of Technology Kharagpur was conferred the Outstanding Teachers Award 2021 virtually in recognition of his all-round contributions to teaching and research in the area of Mechanical Engineering and its interdisciplinary applications and for being an exceptional role model towards motivating a new generation of students and young researchers as a figure of iconic inspiration.

Prof Sukumar Mishra, Department of Electrical Engineering, Indian Institute of Technology Delhi was conferred the Outstanding Teachers Award 2021 virtually in recognition of his outstanding contributions to teaching and research in the area of Electrical Engineering and for mentoring students in innovation and research activities.

INAE Woman Engineer of the Year Award 2021

Indian National Academy of Engineering (INAE) has instituted "INAE Woman Engineer of the Year Award" from the year i.e. 2020 onwards with the 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. Three such awards are given, one each in three categories, (i) Academia, (ii) Industry and (iii) R&D. 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.

The recipients of INAE Woman Engineer of the Year Award 2021 under three categories, (i) Academia, (ii) Industry and (iii) R&D are as under:

Academia

Prof Sharada Srinivasan, Professor, National Institute of Advanced Studies (NIAS), Bangalore was conferred the INAE Woman Engineering of the Year Award 2021 virtually in recognition of her outstanding research into engineering applications and materials characterisation in studying ancient metal artefacts, mining, extractive metallurgy, smelting and alloying.

R&D

Smt Madhumita Chakravarti, Director, Centre for Millimeterwave Semiconductor Devices and Systems (CMSDS), Kolkata was conferred the INAE Woman Engineering of the Year Award 2021 virtually in recognition of her outstanding contributions towards the development and success of Indian Air Defence Systems.

Industry

Ms Vartika Shukla, Chairperson & Managing Director, Engineers India Limited, New Delhi was conferred the INAE Woman Engineering of the Year Award 2021 virtually in recognition of her outstanding contributions towards the growth of the Indian industry in general and Oil and Gas industry in particular.

INAE Young Entrepreneur Award 2021

INAE Young Entrepreneur Award was instituted in the year 2017 to encourage and recognize innovation and entrepreneurship among Young Engineers. The engineering innovations/inventions/ concepts that have been actually realized and implemented in industry either in new processes or products are given weightage.

The recipients of the award for the year 2021 are:

1 **Dr Chandan Kumar Jha,** Post-Doctoral Fellow, Indian Institute of Technology Gandhinagar.

2. **Dr Madhan Balaraman,** Senior Principal Scientist, CSIR-Central Leather Research Institute, Chennai.

3. **Mr Nikhil Kurele,** Cofounder & CEO, Noccarc Robotics Private Limited, Pune, and Mr Harshit Rathore, Cofounder & CTO, Noccarc Robotics Private Limited, Pune.

4. **Dr Sebastian C. Peter,** Associate Professor, Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru.

INAE Young Engineer Awards 2021

The Academy instituted INAE Young Engineer Awards in 1996, to recognize excellence in design and technology transfer, innovative development, and engineering research. The scheme has attracted nominations of bright young talent in the country and has become a prestigious national award since then. So far, 273 young engineers have been conferred this award and their early recognition has encouraged the best upcoming talent to make innovative engineering and technological contributions for our national development. The nominations for INAE Young Engineer Award for the year 2021 were sought from INAE Fellowship, Engineering institutions, R&D Labs. Out of 156 nominations, 38 were shortlisted by the Sectional Committees. Due to the prevailing situation related to the Covid-19 pandemic, the entire final selection process was conducted online through WebEx wherein in the second stage, the shortlisted candidates gave virtual presentation of their work before the Selection Committee on July 30-31, 2021.

The following fifteen candidates were selected and conferred INAE Young Engineer Award 2021. These award winners become "INAE Young Associates" till 45 years of age or their Election as INAE Fellow.

1 Dr Sri Harsha Kota, Associate Professor, Department of Civil Engineering, Indian Institute of Technology Delhi
(Environmental Engineering)

2 Dr Puneet Kumar Patra, Assistant Professor, Department of Civil Engineering, Indian Institute of Technology Kharagpur
(Mechanics)

3 Mr Pankaj Malhotra, Scientist, Tata Consultancy Services, Mumbai
(Machine Learning for Predictive Maintenance, Prognostics and Health Management; Reliability Engineering; & Time Series Analysis)

4 Dr Abir De, Assistant Professor, Department of Computer Science and Engineering, Indian Institute of Technology Bombay
(Machine Learning, Artificial Intelligence & Complex Networks)

5 Dr Neha Khatri, Senior Scientist, Department of Optical Devices & Systems, CSIR-Central Scientific Instruments Organisation (CSIR-CSIO), Chandigarh
(Optical system Design and fabrication for Soft X-Rays & Infrared Optical elements)

6 Dr Sourav Mondal, Assistant Professor, Department of Chemical Engineering, Indian Institute of Technology Kharagpur
(Fluid Flow and Mass Transport)

7 Mr Sri Harsha Nistala, Scientist, Tata Consultancy Services Ltd., Pune
Industrial Analytics; Agglomeration with specialization in Sintering & Pelletization; Thermodynamic modelling; and Process Modeling & Simulation)

8 Dr Abheejeet Mohapatra, Assistant Professor, Department of Electrical Engineering, Indian Institute of Technology Kanpur
(Power network operation and planning & protection in the presence of renewable energy sources)

9 Dr Manas Kumar Jena, Assistant Professor, Department of Electrical Engineering, Indian Institute of Technology Palakkad
(Power Systems Engineering)

10 Dr Manan Suri, Associate Professor, Department of Electrical Engineering, Indian Institute of Technology Delhi
(Electronics & Communication Engineering)

11 Dr Niraj Kumar, Principal Scientist, CSIR-Central Electronics Engineering Research Institute, Pilani, Rajasthan
(Plasma assisted Microwave & sub-THz source)

12 Dr S Mathavaraj, Scientist – SE, U. R. Rao Satellite Center, ISRO, Bengaluru
(Space Trajectory Design; Guidance and Navigation & Control design of Space Vehicles)

13 Dr Samadhan Ananda Pawar, Post-Doctoral Researcher, Department of Aerospace Engineering, Indian Institute of Technology Madras
(Synchronization, Complex Systems, and Control of Instabilities)

14 Dr Chandra Sekhar Tiwary, Assistant Professor, Department of Metallurgical and Materials Engineering, Indian Institute of Technology Kharagpur
(Metallurgical and Materials Engineering)

15 Mr Pushkar Varshney, Senior Research Manager, Life End Processing, Refining Technology, Indian Oil Corporation Ltd., Research & Development Centre, Faridabad
(Refining Technology)

Innovative Student Projects Awards 2021

The Academy has instituted Innovative Students Projects Award since 1998 to identify innovative and creative projects undertaken by the students at three levels B.E./ B. Tech, M.E./ M.Tech and PhD in engineering colleges. This Award recognizes innovative and creative projects and theses of students and research scholars in engineering institutions, since an early recognition of merit and talent can often mark the beginning of a brilliant career.

The first meeting of the Selection Committee was held virtually on August 30, 2021 to initially shortlist the nominees and subsequently the shortlisted candidates made presentation of their work before the Selection Committee during its meeting held virtually on September 30-October 1, 2021. The list of recipients of Innovative Student Projects Awards 2021 is given below. The selected candidates become INAE Student-Members for a period of five years from the year of award conferred.

Doctoral Level

1 Dr Indrasis Das, Indian Institute of Technology Kharagpur
(Bioelectric Toilet: For onsite treatment of blackwater to facilitate reuse of treated water and electricity generation for onsite applications)

2 Dr Arpita Biswas, Indian Institute of Science, Bangalore
(Algorithms for Fair Decision Making: Provable Guarantees and Applications)

3 Dr Vijai Laxmi, Indian Institute of Technology Bombay
(Design and Development of Microdevices for Platelet Rich/Poor Plasma Separation from Blood)

4 Dr Khushboo Suman, Indian Institute of Technology Kanpur
(Microstructure and Viscoelasticity of Physical Gels)

5 Dr Syed Shahjahan Ahmad, Indian Institute of Science, Bangalore
(Modeling, Characterization, Control and Design of Switched Reluctance Machines)

6 Dr Sanghamitra Ghosal, Indian Institute of Engineering Science and Technology Shibpur
(Ternary Hybrid Junctions of Semiconducting Oxide Nanostructures, Reduced Graphene Oxide and Noble Metal for Improved Gas Sensor Device Applications)

7 Dr Syed Idrees Afzal Jalali, Indian Institute of Science, Bangalore
(Evaluation of Power-Law Creep in Bending)

8 Dr Parvaiz Ahmad Shiekh, Indian Institute of Technology Kanpur
(Engineering Bioinspired Polyurethane Scaffolds to Attenuate Oxidative Stress and Hypoxia for Cardiac and Dermal Tissue Regeneration)

Master's Level

1. Ms Vasamsetti Sri Harika, Jawaharlal Nehru Technological University
(Health Monitoring of Structures under Ambient and Vehicle Excitations)

2. Ms Tapadyoti Banerjee, Indian Institute of Technology Kharagpur
(Authenticated Encryption using Cellular Automata)

3. Mr Sampad Laha, Indian Institute of Technology Kharagpur
(The Dynamics of Blood on Paper Matrix and its Implication in Point of Care Diagnostics)

4. Ms Lubna Muzamil Rehman, Birla Institute of Technology and Science-Pilani, K.K Birla Goa Campus, Goa
(Understanding the Thermodynamics of Salt-water systems)

5. Ms Jashaswini Bhuyan, Indian Institute of Technology Bhubaneswar
(Performance Analysis and Optimization of Receive Diversity PLC system with imperfect CSI in Nakagami-m noise environment)

6. Ms Shruti Tandon, Indian Institute of Technology Madras
(Investigating the intermittency route of chaos to order transition in laminar and turbulent thermoacoustic systems)

7. Mr Nampelly Ganesh, Indian Institute of Technology Madras
(Eddy Resolving Simulations of Cavity Flows)

Bachelor's Level

1. Mr Love Kush Tak, Indian Institute of Technology Bombay
   Calorific value determination of Reject Fractions from Mechanical Biological Treatment Plant)

2. Mr Aditya Chetan & Ms Brihi Joshi
   Indraprastha Institute of Information Technology, Delhi
   (Understanding Adversarial Collusive Activities in Online Social Networks)

3. Mr Ashwin Agrawal Mr Rohan Katkar and Mr Suyash Dadmal
   College of Engineering, Pune
   (Design and Development of agricultural harvester mechanism for bulbous crops like onions)

4. Mr Merul Ritesh Shah, Institute of Chemical Technology, Mumbai
   (Design of a brine preparation unit to manufacture 2000 TPD of soda ash using sea water as raw Material)

5. Ms Sakshi Sushant Naik, Indian Institute of Technology Hyderabad
   (Novel strategies in Automated & Physics-driven Deep Learning for Real-time Optimal design of Cascaded Industrial Crystallizers)

6. Mr Ishank Shekhar, Indian Institute of Space Science and Technology, Thiruvananthapuram
   (Generation of 24-Sided Polygonal Voltage Space Vector Structure with Reduced Hardware Complexity)

7. Mr Shashank Tomar, Indian Institute of Space Science and Technology, Thiruvananthapuram
   (Launch Vehicle Landing Trajectory Optimisation)

8. Mr Sontam Govardhan Reddy, Indian Institute of Technology Hyderabad
   (Dynamic modulation of light using plasmonic nanostructures on elastomeric PDMS substrates)

Joint Schemes with AICTE

AICTE-INAE Distinguished Visiting Professorship Scheme

Industry-academia interactions have become essential with world-over technological changes in recent times. The interactions can impart relevant knowledge to the students in the engineering institutions, which is sustainable in the changing conditions. The exchange of knowledge proves to be beneficial for both academic institutions and industries. While industries could use the Academia's knowledge base to improve the industry's internal R&D, quality and global competitive dimensions, academicians benefit from gaining knowledge about dynamics of Industrial real time situations, identifying problems for improved research and using their knowledge and expertise to find practical solution and strengthening of curricula of educational programs being offered at engineering colleges/institutions. INAE together with All India Council for Technical Education (AICTE) launched "AICTE-INAE Distinguished Visiting Professorship Scheme" in 1999. Under this scheme, Industry experts are encouraged to give lectures in engineering institutions. This scheme is popular among industry experts as well as engineering colleges.

Due to prevalence of Covid pandemic, the scheme was operated through a modified Standard Operating Procedure (SOP) allowing existing Distinguished Visiting Professors (DVPs) to deliver lectures online. Existing 54 DVPs conducted classes for their respective associated colleges online and in physical mode. With the travel restriction being removed, some of the DVP s started travelling to campuses of their associated engineering colleges and giving lectures in person.

AICTE-INAE Travel Grant Scheme for Engineering Students

Indian National Academy of Engineering (INAE) launched AICTE-INAE Travel Grant Scheme for Engineering Students jointly with AICTE in 2013 to provide financial support to pre-final and final year Bachelor's and Master's Level engineering students for presenting a research paper in an international scientific event (conference/seminar/symposium/workshop/exhibition etc.) in order to encourage engineering students to engage in research.The scheme facilitates a student to travel abroad and take part in presenting his/her research work in International Platform by providing of 100% Registration Fee, 100% Visa fee, 50% of the actual Airfare for discounted /concessional air ticket, and local travel from the Engineering College/ Institution to the nearest airport and back. Maximum financial support per student towards registration, concessional travel expenditure and visa fees, is limited to Rs. 1 lakh.

AICTE-INAE Travel Grant (TG) Scheme Committee comprising of INAE Fellows from different Engineering Sections was constituted to review the operation of the scheme regularly and select deserving candidates as per defined criteria. The Scheme was promoted by AICTE through print media and by sending mails to Principals of AICTE approved Engineering colleges. Due to outbreak of COVID-19, the scheme was not operational from April 2020- October 2020. A modified SOP was proposed to allow students present their research work online in International Conferences. AICTE accepted the SOP with the condition of reimbursing only registration fee up to Rs. 25000 for students presenting their research paper/poster/project in International Conferences in virtual mode. The scheme resumed in November 2020. Only 8 students could be selected from April 2021 till March 2022.

INAE Travel Grant Scheme for Engineering Students

An "INAE Travel Grant Scheme" for Engineering Students from IITs/ NITs/ Govt. approved Engineering Colleges other than by AICTE had been instituted to present papers abroad for enhancing the quality of engineering education in the country. The objective of the scheme is to provide partial assistance and registration fees to Bachelors and Masters Level engineering students for presenting a research paper Online or Physically in an international scientific event (conference/seminar/symposium/workshop/exhibition etc) in order to encourage engineering students to engage in research. Guidelines were revised, and applications were sought from IITs/ NITs/ Govt. approved Engineering Colleges other than by AICTE. Nominations were invited on the revised Guidelines under this Scheme.

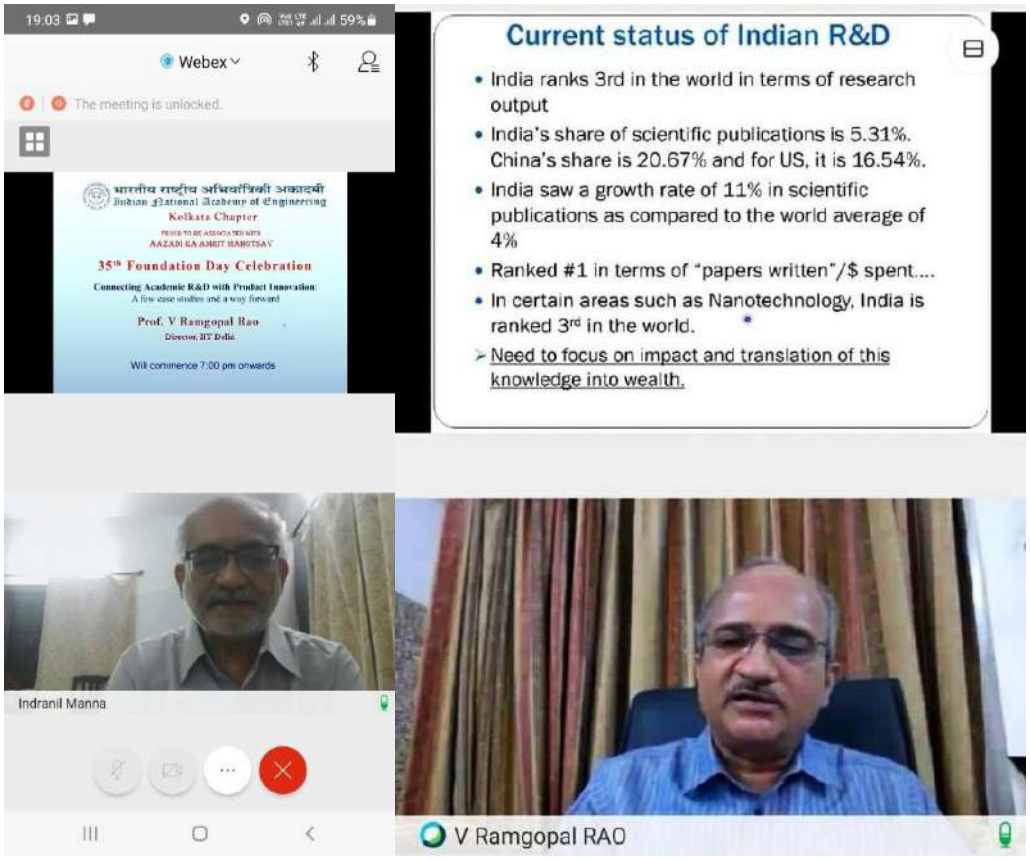
Events Organized by Local Chapters

INAE Local Chapters organized a number of interesting webinars/activities in the last one year some of which are summarized below.

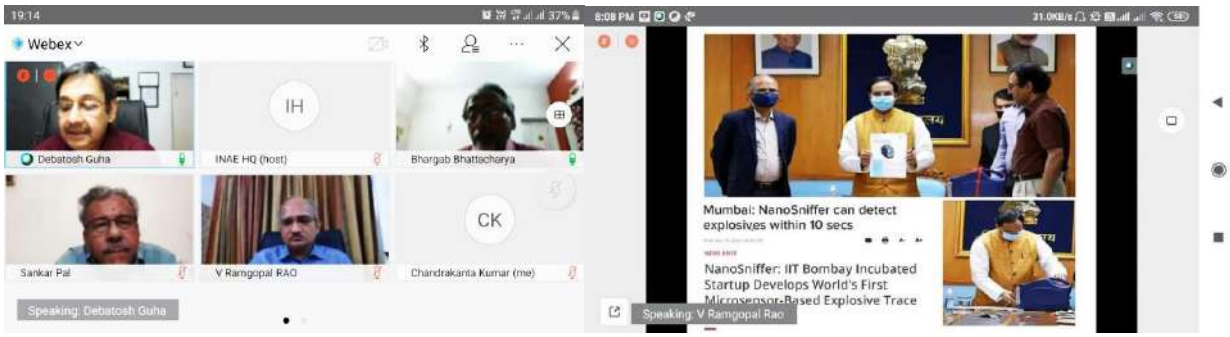
INAE Kolkata Local Chapter

(i) Special Lecture on "Connecting Academic R&D with Product Innovation: A few case studies and a way forward" on 22nd April 2021

Indian National Academy of Engineering (INAE) Kolkata Chapter celebrated INAE Foundation Day on April 22, 2021 in a virtual mode due to Covid-19 pandemic situation. It was a part of celebrating Azadi Ka Amrit Mahotsav. On this occasion, Prof. V. Ramgopal Rao, Director, IIT Delhi delivered a Special Lecture on "Connecting Academic R&D with Product Innovation: A few case studies and a way forward". Prof. Indranil Manna, President, INAE graced the occasion and welcomed the audience. The evening talk on the WebEX platform was attended by about 180 participants who included distinguished fellows of the academy along with young researchers and students from the various academic and engineering institutes of the country. In his mesmerizing talk, Prof. Rao addressed the present issues and methods of translating the academic research outputs to commercially available products, paving the path for Atma Nirbhar Bharat. It was highly motivating and was appreciated by all. The interesting lecture was followed by an interactive Q/A session. Padma Shri Prof. Sankar Kumar Pal, former Director, Indian Statistical Institute, and founding President of INAE Kolkata Chapter had shared the story of inception of INAE Kolkata Chapter as a new entity in 2007 and also encouraged the young engineers to elevate their career with INAE. Prof. Bhargab Bhattacharyya, President, INAE Kolkata Chapter and Prof. Sivaji Chakravorti, Vice-President, INAE were also present the meeting. Prof. Debatosh Guha, Secretary, INAE Kolkata Chapter conducted the proceedings of the meeting.



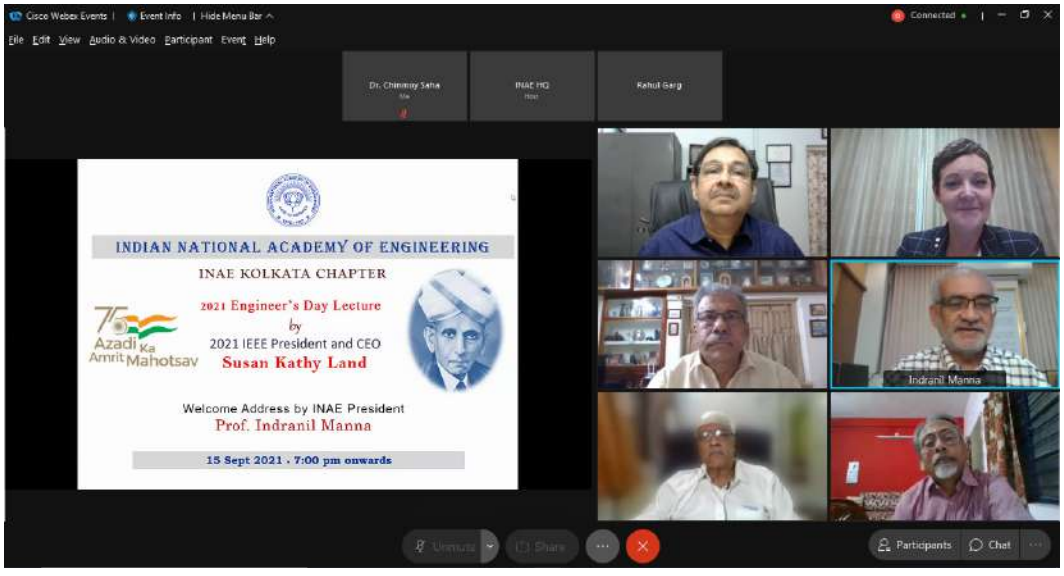
Prof. Indranil Manna welcoming the audience Prof. V Ramgopal Rao delivering his lecture



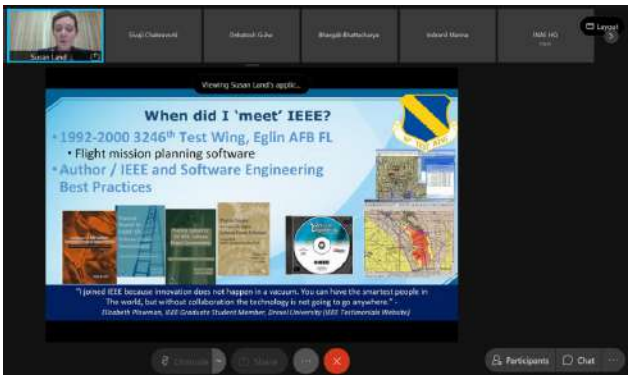
Kolkata Chapter members interacting with the speaker

(ii) 2021 Engineer's Day Celebrated by INAE Kolkata Chapter on September 15, 2021

The INAE Kolkata Chapter honoured the contributions of engineers by hosting the Engineer's Day on September 15, 2021 in virtual mode. It was also a part of the continuing Azadi Ka Amrit Mahotsav program. On this occasion, IEEE President and CEO, Ms Susan Kathy Land delivered the Engineer's Day Lecture on "My Personal Journey with IEEE". Prof. Indranil Manna, President, INAE, graced the event and welcomed the audience. He presented a brief sketch of INAE activities and recalled the life and work of Bharat Ratna M. Visvesvaraya, whose birth anniversary is celebrated every year in India, as Engineer's Day. Prof. Bhargab Bhattacharya, President, INAE Kolkata Chapter, highlighted how the work of engineers is recognized as major enabler for nation building on this Engineer's Day, and also by the professional organizations such as INAE and IEEE. Prof. Sivaji Chakravorti, Vice-President, INAE, introduced the speaker with the audience. The evening talk on the WebEx platform was attended by large number participants of widely varying ages and interests. They include distinguished fellows of the academy along with young researchers and students from the various academic and engineering institutes of the country. In her talk, Ms Susan portrayed her personal journey as woman engineer specializing in software development and defense research, recollecting the challenges that she had experienced in the early eighties as a computer professional. The story of her participation in the IEEE activities first as an ordinary volunteer, then with an active role in the leadership programs of IEEE, and finally touching the topmost position of the world's largest professional society was truly exciting and motivating to any young engineer! The lecture was followed by an interactive session. Padma Shri Prof. Sankar K. Pal, former Director, Indian Statistical Institute, and founding President of INAE Kolkata Chapter, had shared his views as a concluding part of the meeting. Prof. Debatosh Guha, Secretary, INAE Kolkata Chapter, volunteered to oversee the entire planning of the event, and conducted the proceedings of the meeting.



Prof. Indranil Manna welcoming the audience.



Ms Susan Kathy Land delivering her lecture.

Interactions with the audience.

(iii) 2022 National Science Day Celebrations on 1st March 2022

Indian National Academy of Engineering (INAE) celebrated the National Science Day 2022 on 1st March 2022 (Tuesday) and to commemorate this important event, INAE Kolkata Chapter organized online special lectures delivered by two eminent scientists and academic leaders of the country through WebEx Platform. Prof. Indranil Manna, President, INAE, graced the event and delivered the welcome addresses. He emphasized the importance of the day to the audience and also to the scientific and technical community of the country. Prof. Manna introduced the eminent speakers to the audience.

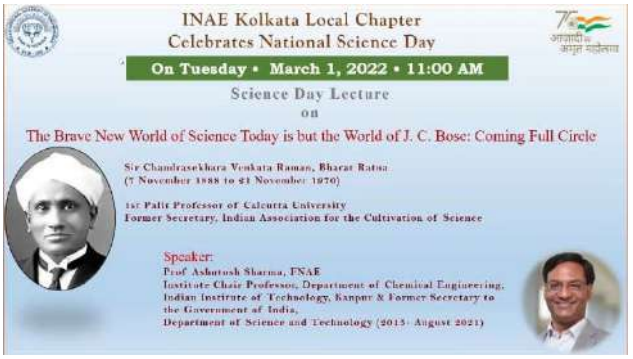
The first talk of the day was presented by Prof. Ashutosh Sharma, Former Secretary, DST, Govt. of India and Professor of Chemical Engineering Department, IIT Kanpur. The title of the talk was "The Brave New World of Science Today is but the World of J. C. Bose and C.V. Raman: Coming Full Circle". In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

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

Both the talks were extremely informative, full of wisdom and thought which deeply engrossed the audience. Prof. Debatosh Guha, Chairman, INAE Kolkata Chapter proposed the formal vote of thanks and expressed gratefulness to both speakers on behalf of the INAE. Lt. Col. Shobhit Rai, Deputy Executive Director, INAE oversaw the entire planning of the event.

Prof. Indranil Manna welcoming the audience

Glimpse of the Museum at Bose Institute, Kolkata



Prof. Ashutosh Sharma delivering his lecture

Dr. Shekhar C. Mande delivering his lecture

INAE Bangalore Local Chapter

(i) Workshop on "Smart Cities in Karnataka: Experiences and the Road Ahead" on 17th April 2021

The Indian National Academy for Engineering (INAE), Bangalore Chapter, along with Indian Institute of Science (IISc), Center for Study of Science, Technology and Policy (CSTEP), and National Institute of Advanced Studies (NIAS) Bangalore organized a workshop "Smart Cities in Karnataka: Experiences and the Road Ahead." The Urban development Department of Karnataka participated as the Government partner for this event. The objectives of this workshop were mainly to explore the experiences in Smart City implementation in Karnataka through the eyes of different stakeholders, and to understand the challenges in implementation and explore solutions and future strategies. This event held online on 17th April 2021 was actively participated by around 50 participants, most of who were active stake holders from various government departments, local bodies and Smart City projects.

The chief guest at the Inaugural Session of the workshop were Mr. M. T. Reju IAS, MD of Karnataka Urban Infrastructure Development and Finance Corporation (KUIDFC). Prof. Indranil Manna, President, INAE, and Dr. Vasudev K. Aatre, Chairman, INAE, Bangalore Chapter. Were also present at the Inaugural session. Prof. Indranil Manna, the President of INAE opened the session emphasizing the need for transformation of knowledge into societally feasible solutions, citing the example of Smart City initiative. In addition, he suggested that INAE can contribute its expertise and experience to the progress of engineering and technology for policy and implementation.

In his Keynote address Mr. M. T. Reju, IAS, MD of KUIDFC, talked about the smart city projects that are undertaken in Karnataka under the Smart Cities Mission (SCM). He mentioned several aspects that need improvement, such as the technological and the governance challenges faced during the implementation of these projects and the need to arrive at strategies that can be used to make these more successful in future. He mentioned that he expects this workshop to propose answers for their main concerns in the form of constructive inputs to make the smart cities programs more effective. Dr. Vasudev K Aatre in his address stated that urbanization and migration pose significant strain on cities' assets, resources, and services and that it is critical to address this issue with modern technologies.

The first half of the workshop included a Plenary Session on four Thematic areas:

1. Transport (Moderator: Ashish Verma, Speaker: Ms. V Manjula IAS)
2. Water and Sanitation (Moderator: Ashish Srivastava, Speaker: Dr. Dinesh Mehta)
3. Solid Waste Management (Moderator: Carol Upadhya, Speaker: Dr. H N Chanakya)
4. Disaster Resilience, Environment, and Ecology (Moderator: Amit Mukherjee, Speaker: Dr. T V Ramachandra)

Ms. V. Manjula IAS, Commissioner, Directorate of Urban Land Transport (DULT), GoI, in her Plenary Talk, highlighted the mobility landscape in Karnataka describing steps taken to shift people to using public transport, and the mobility-related objectives of SCM. She also discussed some of the key aspects to be focused and provided recommendations. Dr. Dinesh Mehta, Executive Director of the Center for Water and Sanitation (CWAS), CEPT University, provided a broad overview of water and sanitation projects in Indian smart cities. He also highlighted the need for streamlined information on water and sanitation to leverage smart analytics and deliver improved services across the water management lifecycle in smart cities.

Dr. H.N. Chanakya, Centre for Sustainable Technologies, IISc, highlighted the long history of innovations in solid waste management (SWM) in Karnataka and made several suggestions on the way forward, such as adopting bio-methanation and other long-term solutions, effective system for monitoring the implementation of projects. Dr. T V Ramachandra, Centre for Ecological Sciences, IISc, provided a broad overview of environment and ecology projects in Karnataka, discussed the consequences of unplanned urbanization and lack of integrated planning approach.

Several representatives of various Smart City projects in Karnataka participated in Breakout Sessions organized after lunch, focusing on the above themes. They identified successes, deliberated on some failures, proposed several useful recommendations to address these. Moderators presented a short summary of these Sessions at a joint Closing Session. In his Closing Remarks, Dr. Aatre mentioned that recommendations under various themes of this workshop will be prepared by INAE, Bangalore section and will be circulated to the Government of Karnataka and INAE HQ for appropriate action.

(ii) INAE Foundation Day celebrated by INAE Bangalore Chapter on April 20, 2021

INAE Bangalore Chapter celebrated the INAE Foundation Day on April 20, 2021. Meeting was held online through Google meet. Over 60 fellows from the Bangalore Chapter attended the event. The meeting held between 11.0 am to 12.30 pm and it is a part of "Azadi ka Amrit Mahotsav" celebration, which INAE is taking part in a big way.

The meeting began with a welcome address by Dr A R Upadhya FNAE and Vice Chairman of the INAE Bangalore Chapter, followed by a presentation by Prof. S. Gopalakrishnan FNAE and the Secretary of INAE Bangalore Chapter. In his report, Prof. Gopalakrishnan, presented the various activities undertaken by Bangalore Chapter, which included the outreach activities, Webinars and workshops. He also informed that the Bangalore Chapter will soon start the annual Prof. Roddam Narasimha Memorial Lecture to be held every year starting this year and the event will be held July 20, which happens to be Prof, Narasimha's birthday.

Following this there were two lectures from two very distinguished scientists on the following topics:

(a) Building New Institution-Challenges and Opportunities

This talk was given by Prof. P Seshu, Director, IIT Dharwad. In his talk, he talked about the initial challenges such as getting land, building infrastructure, recruiting faculty etc and also presented how the institution has progressed and some of the academics distinctions the students and faculty have achieved over the last few years

(b) Evolving a business model for commercialization of Grassroots Innovation

This talk was delivered by Dr V Bhujanga Rao FNAE and Former Director General DRDO. Dr Rao has been working with INAE to tap the innovation potential in rural India and presented some excellent case studies in his talk

Both talks were well received with a lively question answer session. Following this, Dr V K Aatre, FNAE and Chairman, INAE Bangalore Chapter addressed the fellows where he outlined the vision of INAE Bangalore Chapter and extoled the fellows to attend the INAE monthly webinar in large number. The function ended with a vote of Thanks by Prof. S. Gopalakrishnan, Secretary , INAE Bangalore Chapter

(iii) Webinar in the series of Frontiers of Engineering on "Harnessing of Solar Energy Through Photothermal Conversion" on April 29, 2021

INAE Bangalore Chapter organized the Webinar in the series of Frontiers of Engineering on "Harnessing of Solar Energy Through Photothermal Conversion". The talk was delivered by Dr. Harish Barshilia from CSIR-National Aerospace Laboratories, Bangalore, India. He gave an overview of the state-of-the-art absorber coatings used for harnessing solar energy. He discussed various performance evaluation accelerated ageing tests for predicting the service life of the coated components, which can exceed 25 years. He gave a brief overview of related technologies such as anti-reflection, self-cleaning, etc. and also discussed future trends in solar thermal technologies in the country.

(iv) Webinar in the series of Frontiers of Engineering on "An Overview of Smart Manufacturing and its Implications for Innovation and Growth" on June 24, 2021

INAE Bangalore Chapter organized Frontiers of Engineering Webinar on June 24, 2021 on "An Overview of Smart Manufacturing and its Implications for Innovation and Growth" by Prof. Amaresh Chakrabarti from the Center for

Product Design and Manufacturing at the Indian Institute of Science, Bangalore gave a talk on smart manufacturing, Industry 4.0, and its importance for India's manufacturing sector. He argued that a rapid transformation of the manufacturing sector is needed for aligning India with global practices. His talk gave an overview of the major concepts and technologies in smart manufacturing. He discussed the need for innovation in this area, and gave examples of innovations that can support this transformation. He concluded his talk with a glimpse of the indigenous smart factory that is being developed at IISc. The talk was attended by 20 attendees and had a lively question and answer session. The talk video is available on INAE Bangalore Chapter's YouTube channel.

(v) Webinars in the series of Frontiers of Engineering on "Advent of AI in Medical devices" on July 31, 2021

INAE Bangalore Chapter organized a Frontiers of Engineering webinar on "Advent of AI in Medical devices". The talk was delivered by Dr Gopal Avinash, Global leader of Data Science, GE Healthcare's Edison AI Services on July 31, 2021 (Saturday) from 11 am-12 noon. Dr. Gopal Avinash pointed out that in the current decade, machine learning based software applications are becoming more common, and that well-funded startups are being formed to analyze medical data. He discussed the process of building smart imaging medical devices to generate image data. He spoke about smart workflows to simplify consistent data acquisition. He delved deeper into imaging devices. He also discussed regulatory considerations that are essential for bringing out the AI embedded devices to market. In the future, he anticipated that the integration of AI embedded medical device along with AI based medical data analysis would transform the healthcare industry and deliver healthcare to the world. The talk was extremely well attended with more than 80 attendees.

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

(vii) National Webinar on "Ethics in Higher Education" on 25th June 2021

INAE Bangalore Chapter organized National Webinar on "Ethics in Higher Education" on 25th June 2021 jointly with Society for Professional Ethics & Management & Indian National Academy of Engineering (INAE) with support from National Assessment and Accreditation Council (NAAC), Jain (Deemed-to-be-University), Visvesvaraya Technological University (VTU) and other academic institutions. A large number of participants from academic institutions and other management participated, mostly faculty and management / administrative persons and a few students. Summary of the program is given below:

- Welcome introductory remarks *by Prof. Sridhara Murthy*
- Introduction about Webinar by Dr.*CG Krishnadas Nair*, *President, Society for Professional Ethics and Management*
- Special address by Prof. Indranil Manna, President, Indian National Academy of Engineering (INAE)
- Keynote address by Dr.SC Sharma, NAAC
- UGC requirements for teaching Ethics and Environment by Prof. Upendra, Resource person from University Grants Commission

- Evaluation and accreditation of academic institutions with emphasis on Ethical practices by NAAC
- Indian Heritage on Ethics based education, Gurukula Systems, student teacher relationship by Dr. R.N.Iyengar, Distinguished professor.
- Ethical responsibility of Engineers, Managers and their teachers by Dr. Karisiddappa, Vice Chancellor, VTU Interactive Panel and Discussion
- Role of teachers / students and management of academic institutions led by Prof. K.R.Sridhara Murthi, Director (Academics and Planning), Jain University.

There was considerable discussion on the need for ethical education to start from home and primary education through parents and teachers, followed by further development of values and ethics along with responsibilities to the Society Sustainable development and Environment during the higher education as prescribed by UGC. Comments / suggestions were also made on the present curricula and guidance given by the UGC and the need for uniformity of detailed Course Content and the Method of delivery. The need for various academic institutions to interact with industries, NGOs and various professional societies, professional ethics and specific code of conduct evolved by these organizations for each type of profession and familiarize the graduating students on these depending upon their disciplines. A White Paper on ethics based on the webinar has been prepared which is given below.

A White Paper on Ethics Based on National Webinar On 'Ethics In Indian Higher Education' Organized By Society For Professional Ethics & Management and Indian National Academy of Engineering and Supported By Jain University and VTU

Ethics are central to all human development in the current knowledge era where technological innovations and human organisations are playing a pivotal role in shaping the pace and progress of societies. The most effective way to bring ethical consciousness to play its rightful role is to build it from the very early stage of person's life, particularly from primary education stage itself. Given the complexity of structures which navigate the enormously diverse functions and professions in society, the codes and standards in various professions had been instrumental value in the practice of ethics. In this context, the Indian heritage and traditions could be of seminal value for the development of ethics. The current trend of educational reform to provide student centric and holistic education finds its echoes from the rich heritage in ancient India which used to inculcate spirit of equality, social awareness and practical efficiency in pupils and thus leading the education system towards the highest level.

The driving vision of knowledge society and an ideal student teacher relationship, which were the main pillars of the ancient Gurukul system, were also the key motive forces for growth of indigenous education systems to great heights in the form of well-established institutions of universal fame. The ethos, principles and the philosophy of such a system if adapted to the current times and assimilated into the national education systems, it can be transformative. The system saw that the teacher irrespective of the subject taught was fired by the idea of transferring the cultural and intellectual treasure bequeathed successively passed to the next generation with further value addition in terms of new theories, discoveries and monographs. The missing synchrony in the current student-teacher relationship with the emotional concept of belonging to a hoary intellectual heritage needs to be restored.

Ethical practices in different professional streams and those within the corporate world as well as other types of institutions vary but yet an assimilation of essential principles into the very culture of those systems remain relevant, Advances in modern information and communication technologies which enhance access to modern information and knowledge and provides diverse learning tools in learner centric environments should be taken advantage of. Their use should ensure inclusivity and an understanding of what is right and what is wrong, should remain at the core of all learning and action

It is necessary to recognise the dynamic nature of ethical standards evolved by the professional societies and there is continued need to renew and keep them updated in the light of new challenges in the environment. Ethics can more powerfully be imparted through real life examples and role models. Recognition by the professional societies of such

role models and exemplary behaviour will go a long way to inspire ethical behaviour in society. Learned societies can also play a role in bringing out case studies and publications in this field which will be of immense value.

Educational institutions can also benefit from explicit statement of professional code of ethics and also organized mechanisms for promoting social activity. Human Network Academy in Jain University and Universal Human Value Cell in the Visvesvaraya Technological University are some examples. Growth of such units and creating channels for expression of views and ideas from younger generation on the themes related to ethics should be encouraged.

Ethical questions relating to human interactions with environment is receiving greater and greater attention in the recent times. Issues related to climate change has come into sharp focus globally, bringing in the questions relating to the diversity of policies and standards in different countries and also varying implications of common global policies and approaches for preservation of the environment. Conflict between the development and livelihood questions and conservation of environment have also been posing critical questions in the national context. In pursuance to the judgment of Supreme Court of India, all higher education institutions in the country have been directed to include environmental science/studies in their curricula since 2013. Education in courses relevant to environment in the higher education institutions are benefitted by several career opportunities which are opening up. Academia needs to review and provide inputs for updating and diversifying curricula in the light of constantly unfolding research and applications in the fields related to environment. There is need for mission mode focus to tackle many issues like solid waste management, particularly the plastic wastes. It is noted that 5 to 6% of the total municipal solid waste is plastics. Among the endeavours to recycle plastics, progressive down cycling can be adopted as an option. For example, PET bottles are being recycled to produce T-shirts. There should also be effort to generate credible and actionable data.

(viii) First Roddam Narasimha Memorial Lecture on July 20, 2021

The first Roddam Narasimha Memorial Lecture was held on July 20, 2021 at 6.0pm through on-line mode via Google Meet. This memorial lecture was instituted by the INAE Bangalore Chapter with the support of INAE Headquarters, New Delhi. The inaugural lecture was delivered by Prof. K R Sreenivasan, Distinguished University Professor, New York University USA. Over 100 fellows and participants from all over the world participated in this lecture. The event was inaugurated by Mrs Neelima Narasimha, wife of Late Prof. Narasimha.

The event began with a welcome address by Dr V K Aatre, Chairman, INAE Bangalore Chapter. Following his welcome address, Prof. G. Jagadeesh, Member, INAE Bangalore Chapter and Professor, Department of Aerospace Engineering, IISc Bangalore, presented Professor Narasimha's technical contribution in the area Fluid Dynamics and his pioneering work in the Laminar-to-Turbulent flow transition. Prof. Narasimha had contributed significantly to various National Aerospace Programs over last 5 decades for the country and his contributions were documented in the form of a video, which was prepared by National Aerospace Laboratories, Bangalore. This video was next played to provide the attendees a bird's eye view of Prof. Narasimha's contributions to the National Aerospace Programs. Following this, the President of INAE Prof. Indranil Manna addressed the gathering, wherein, he fondly recalled Prof. Narasimha's Seminal contributions and his own association with him. Following the address of INAE President, the Memorial Lecture was inaugurated by Mrs Neelima Narasimha, wife of late Prof. Narasimha. In her address, she recalled the personality of Prof. Narasimha and the passion he brings into his work culture.

The Roddam Narasimha Memorial Lecture was given by Prof. K R Sreenivasan, Distinguished University Professor, New York University, USA and one of the most Prolific Students of Late Prof. Narasimha. His talk was on the "Contributions of Prof. Roddam Narasimha in the area of re-laminarization Research". Prof. Sreenivasan elegantly brought out the contribution of Late Prof. Narasimha and his students in this area and showed how his research is still relevant in today's fluid dynamic research and still highly cited. He blended his talk very well by mixing Prof. Narasimha's Technical contribution with some personal flavour making the talk extremely

enjoyable. The program ended at 7.30 pm with a vote of thanks proposed by Prof. S. Gopalakrishnan, Secretary, INAE Bangalore Chapter.

(ix) Lectures organized on the occasion of Engineer's Day on September 15, 2021

INAE Bangalore Chapter organized the following two Lectures on the occasion of the Engineer's Day on September 15, 2021.

(a) Prof. Ananth Ramaswamy, Chair, Department of Civil Engineering, IISc, Bangalore on " Achievements in civil structures and engineering in India"

(b) Dr V K Aatre, Chairman, INAE Bangalore Chapter, and Former SA to RM, DRDO on "India becoming a technology powerhouse "

(x) SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series held on June 30, 2021 featuring talk by – by Padma Bhushan Awardee, Chancellor of IIST and former President, INAE - Dr BN Suresh, on "Mastering Rocket Science: Experiences and Excitements".

SAMVAAD is a monthly lecture series organized jointly by IIT Dharwad and Indian National Academy of Engineering - Bangalore Chapter (INAEBC) to leverage the wisdom and experience of INAE for the benefit of faculty and students. On 30th June 2021 at 4 pm, Dr B N Suresh, Chancellor of IIST and a Padma Bhushan awardee, delivered an enthralling talk on "Mastering Rocket Science: Experiences and Excitements" on Google Meet online video conferencing platform. The talk captured the glorious journey of India's tryst with rocket science spanning over five decades and in making us "AtmaNirbhar ". The talk gave an overview of "Rocket Science" to the uninitiated. The talk was simultaneously streamed on YouTube (https://www.youtube.com/watch?v=6zBKZ-YWXHA) for the benefit of a wider audience including fraternities from technical institutes in Karnataka and CFTIs.

After the presentation, Dr BN Suresh took queries from audience members including students, faculty and other esteemed members of INAE. The questions spanned technical domains including systems integration and reliability, effect of various natural phenomena like combustion and lightning, current research areas of ISRO and policy-decision domains like need for introducing reliability in UG programs and commercialization of ISRO expertise for civilian areas. The talk ended with closing remarks from Prof. Seshu who thanked Dr Suresh for the nice talk and for extending his support in making IIT Dharwad a center for excellence in Aerospace Engineering.

(xi) "3rd SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series" on 28th July 2021

SAMVAAD is a monthly lecture series organized jointly by IIT Dharwad and Indian National Academy of Engineering - Bangalore Chapter (INAEBC) to leverage the wisdom and experience of INAE for the benefit of faculty and students. INAE Bangalore Chapter organized a live session of "3rd SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series" on 28th July 2021 from 5:30 PM - 7:00 PM wherein Prof. Kaushik Rajashekara, FIEEE and Distinguished Professor University of Houston, delivered a talk on " Electric Vehicles - Current Trends and Future Strategies on Google Meet online video conferencing platform. The talk captured the journey of electric vehicles. The talk was simultaneously streamed on YouTube

https://www.youtube.com/watch?v=pW4IVHVM238) for the benefit of a wider audience including fraternities from technical institutes in Karnataka and CFTIs.

(xii) 5th Foundation Day and 4th SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series on 28th August 2021

IIT Dharwad celebrated its 5th Foundation Day on 28th August 2021 along with 4th SAMVAAD - a monthly lecture series organized jointly by IIT Dharwad and Indian National Academy of Engineering - Bangalore Chapter

(INAEBC). Dr. Anil Kakodkar, Padma Vibhushan and Former Chairman, Atomic Energy Commission, delivered a talk on "India's energy security in a carbon constrained world" on Google Meet online video conferencing platform. The talk highlighted the current energy security status and strategies to address them . The talk was simultaneously streamed on YouTube (https://youtu.be/_RvgC_D0WJw) for the benefit of a wider audience including fraternities from technical institutes in Karnataka and CFTIs.

(xiii) 5th SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series on 30th September 2021

INAE Bangalore Chapter organized a live session of 5th "SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series" on 30th September 2021 from 4 PM - 5:00 PM wherein a Lecture on "Decarbonisation and Hydrogen Economy for India" was delivered by Dr Anuradda Ganesh, Director and Chief Technical Advisor, Cummins India.

(xiv) 6th SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series on October 27, 2021

6th SAMVAAD Lecture by Former Director and Chief Designer of LCA, Dr Kota Harinarayana, on "Aatmanirbhar Bharat in Aviation-- From Light Combat Aircraft to Regional Transport Aircraft Development" was held online on October 27, 2021. Dr Kota Harinarayana, a Padma Sri awardee and former Programme Director and Chief Designer of India's Light Combat Aircraft (LCA) Tejas Programme, delivered a very enthralling talk on "Aatmanirbhar Bharat In Aviation-- From Light Combat Aircraft to Regional Transport Aircraft Development". The 6th SAMVAAD talk was organized on Google Meet online video conferencing platform on 27th October 2021 at 4 pm. The talk captured the efforts of us becoming Aatmanirbhar in aviation technology and was simultaneously streamed on YouTube (https://www.youtube.com/watch?v=zgrxplILhVc) for the benefit of a wider audience including fraternities from technical institutes in Karnataka and CFTIs.

(xv) 7th SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series on November 24, 2021

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

(xvi) 8th SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series on 28th January 2022

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

(xvii) 9th SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series on 23th February 2022

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

(xvii) 10th SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series on 30th March 2022

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

(xviii) One-day Workshop on "Technologies for Transformation of Indian Agriculture" on January 10, 2022

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

"Technologies for Transformation of Indian Agriculture" held on January 10, 2022 -Workshop Report

Executive Summary

The executive summary first presents the background, objectives, and structure of the workshop. This is followed by the key observations made by the experts during the workshop and key recommendations made in the various sessions. Details of the observations and recommendations are available in Sections 1-6.

Background and Objectives

The agriculture sector contributes to 16% of India's GDP employing almost 50% of the total work-force. 85% of the farmers are small and marginal, holding less than 5 acres of land and they do not have access to technology that is accessible to the more prosperous farmers. Agriculture in India is largely dependent on nature; variable climate and more recently global warming make farming both challenging and volatile. Despite significant improvement in food grain production and innovations in agricultural technologies spurring a transformation in agricultural practices and helping increase farmer income, Indian farming continues to be plagued by several complex challenges: soil degradation, 63% of farm-land being rain-fed, low productivity, high levels of water usage, environmental damage, unaffordable farm machinery, lack of skills, lack of knowledge, suboptimal usage of information, etc. The cumulative impact is that farmers continue to be trapped in a vicious circle of low growth, low income, and high debt.

To initiate a scholarly discussion on addressing these challenges, the Indian National Academy for Engineering (INAE), in collaboration with the Indian Institute of Science (IISc), the University of Agricultural Sciences (UAS), and the Indian Institute of Horticultural Research (IIHR), organized an intense, one-day agri-technology workshop with active participation from leading academics, scientists, industry practitioners, entrepreneurs, and agriculturists working and interested in different aspects of agricultural technologies.

Technology, especially with the advent of digital technology and data analysis tools, has the potential to transform agricultural practices to achieve high levels of productivity, efficiency, and wealth creation for farmers and the nation. The objective of this workshop is to gain a deep understanding of the role of modern technology, survey the current state-of-the-art in India and abroad, identify implementable solutions, understand the challenges of implementation, and recommend future strategies and policies. In particular, with around 85% of farmers in India being small and marginal, cumulatively holding 50% of the farm-land, and with high operational costs, there is a pressing need to focus on customized and suitable technologies for this demographic.

Workshop Structure

The workshop commenced with welcome addresses by Prof. K. B. Umesh, UAS, Bangalore and Prof. Indranil Manna, President, INAE. This was followed by addresses by guests of honour: Prof. S. Rajendra Prasad, Vice-Chancellor, UAS, Bangalore; Prof. Usha Vijayraghavan, Dean, Division of Biological Sciences, IISc, Bangalore; and Dr. B N Srinivasa Murthy, Director, ICAR-IIHR, Bangalore.

The workshop expectations and outcomes were then outlined by Prof. V. K. Aatre, Chairman, INAE, Bangalore Chapter. This was followed by a plenary talk by the chief guest, Prof. S. Ayyappan, former Director General, ICAR and Chairman, Karnataka Science and Technology Association. Following this, there were five keynote talks:

1. Precision Agriculture: Prof. M.S. Sheshshayee, UAS, Bangalore
2. Farm Mechanization: Dr. C.R. Mehta, Director, ICAR- CIAE, Bhopal
3. Secondary Agriculture: Prof. Chindi Vasudevappa, Vice Chancellor, NIFTEM, Kundli, Haryana
4. Artificial Intelligence and Machine Learning (AIML) in Agriculture: Prof. Y. Narahari, IISc, Bangalore
5. Industry and Academia Interface: Mr. S. Sivakumar, Group-Head, Agri and IT Businesses, ITC Limited

The above sessions were moderated by Dr. Nipun Mehrotra, Founder and CEO, The Agri Collaboratory.

In the afternoon, four parallel panel sessions were organised:

1. Precision Agriculture: Moderated by Prof. Jaywant Arakeri, Professor, Mechanical Engineering, IISc, Bangalore
2. Farm Mechanization: Moderated by Dr. G. Senthil Kumaran, Principal Scientist, IIHR, Bangalore
3. Secondary Agriculture: Moderated by Dr. C.T. Ramachandra, Associate Professor, University of Agricultural Sciences, Bangalore
4. AIML in Agriculture: Moderated by Mr. Ravi Trivedi, Officer on Special Duty, Agriculture, Indian Administrative Fellowship, Government of Karnataka

This was followed by the valedictory session where the four panel moderators summarized the deliberations in the respective panel sessions. This was followed by the address by the Chief Guest, Mr. Shivaraju Boraiah, Additional Director of Agriculture, Govt. of Karnataka. After the concluding remarks by Prof. V.K. Aatre, Mr. V.V.R. Sastry proposed a vote of thanks.

Key Observations

Many key observations were made by the invited speakers, panelists, and participants on all aspects of technology enabled transformation of Indian agriculture. The important ones are summarised below.

Focus on the technologies needed by the farmers: Technology should transform Indian farmers to agri-preneurs. They should become the stakeholders in a digital platform that provides a variety of services including access to credit and insurance and to agri advisories. Although there are roadblocks to integrating digital technology with agriculture in terms of accessibility and adaptability, farmer-centric solutions are important and hence using social sciences within the scope of technology is much needed.

Address the pain points: We should not come up with great technology and push it onto the farmer; instead, we should identify the pain points of the farmer and then build the AI based algorithms and technology that will help alleviate the pain. AI is not a silver bullet. It should only be used to solve realistic problems where it can add value.

The Government has not been able to convince farmers about MSP in Punjab. Many tall claims are made but realising actual material benefits and convincing the farmers are most important. Simple material improvements like cheaper/ better fertilizer, better water management, and better nutrients go a long way and improve the trust of the farmer in technology. China does not use AI but does much better with lower fertilizer than India even though it has less arable land. Use whatever AI technology that is appropriate, concentrate on the important issues like water, credit, and market access.

Enable easy access to technology: It is a mission failure if farmers do not get direct access to the technology benefits. Solutions need to be at scale. Any technology that is produced should be as inexpensive as possible to penetrate deep into the market and especially to small and marginal farmers. Barriers to entry should be zero or negative. The real moonshot is transform technology advances to services that are simple, explainable, and farmer-friendly.

Need for a Multidisciplinary and Partnership Approach: Encourage the engineering and scientific communities to come together to help agriculture. Co-hosting and co-locating several disciplines to enhance partnerships and multi stakeholder collaboration between domain research, industries, academia, and agri start-up ecosystems provide the key to improving innovation. Successful examples include: co-location of multiple streams within the campuses at Cornell University, Australian National University, and University of California, Davis. In the Bangalore context, the Bangalore Science Cluster and the proximally located IISc, IIHR, UAS could come together to set up a centre of excellence to catalyse multidisciplinary interactions.

In order to contribute influentially to the agriculture ecosystem, academics should blend blue sky research coupled with start-up type enthusiasm and innovation. Start-ups could help in engineering solutions partnering with domain players.

Need for Systems Thinking: There is a need for a systems level thinking and multi-stake holder collaboration between policy makers, academia, research scientists, industry and startups to accelerate transformation. A leaf can be taken out of the success of ITC which has partnered with 24 academic and research institutions; 83 government entities across centre, state and district levels; 82 NGOs for execution; and 45 industry enterprises including 13 Agritech start-ups.

Precision agriculture is interdisciplinary: Precision agriculture is highly interdisciplinary, and there is huge scope and need for collaboration and close interaction among agricultural scientists, mechanical, electrical and computer engineers and industry to develop precision agriculture technologies. But India does not have institutes that have experts in all these disciplines in one place, thus requiring collaboration across institutes and labs.

Precision agriculture challenges: Small landholdings; huge diversity in climatic and soil conditions and in cropping patterns; skilled labour shortage.

Focus on India specific precision agriculture: Fundamental research on different aspects (movement of fertilizers, pesticides in soil, absorption of pesticides, drone imaging and spraying, etc); Development of precision agriculture specific sensing systems: temperature, humidity, light, imaging, wireless sensor networks and sampling tools for pest detection and soil health; Development of precision agriculture technologies – water & nutrient delivery systems, mitigating hardwater problems, multispectral image analysis, sensor plant health/stress, nutrition, non-chemical based pest and disease management.

Economically viable precision agriculture: Precision agriculture may be developed for high-value crops and protected agriculture which is more economically viable; there is room for development of new technologies – imaging, sensing, delivery systems, robotic systems – that can be taken to open-field agriculture. Some target commercial

crops: Tea, Coffee, Sugarcane, Cotton, Grape. Identify more crops where precision agriculture techniques could act as catalyst for increasing the income of farmers.

Key considerations for farm mechanization: Marginal land holdings and labor shortage imply that affordability, equipment size, and minimal human intervention are important considerations for farm mechanization along with the need to optimize life cycle cost of ownership, down time, drudgery, etc.

Farming as a service: Subscribe to a service at various stages of the farming lifecycle – pest control, optimal fertilizer application, water management, soil health monitoring, planning for harvest, etc. Uberization of precision agriculture technologies for large scale adoption in farming is promising: companies own the high-technology machinery and provide services like spraying, de-weeding, etc.

Educate and train the farmers: Training aspect of farmers is very important for grassroot adoption. Social media will play a big role here. Use of technology and algorithms should be easily explainable to the farmers.

Secondary agriculture presents a big opportunity: The secondary agriculture sector is a sunrise sector for the Indian economy as it has a major role to play in employment generation, poverty alleviation, and product diversification. Secondary agriculture is one of the ways to achieve holistic and inclusive development of the farmers, forest dwellers, and cattle owners. A big opportunity for manifesting science and engineering for agriculture is in food processing with post-harvest losses ~Rs. 90,000 crores, including input water wastage (3500 litres/kg of rice, 1500 litres/kg of wheat), there is a pressing need for better technology for processing, value addition, food safety, and quality assurance.

Attract the Youth towards Agriculture: Initiatives need to be taken to attract fresh talent towards agriculture, highlighting it as an attractive career option for India's youth. The start-up ecosystem which is crucial to technology enabled agriculture could become an attractive avenue in this context.

Famer Cooperatives: Amul has set a benchmark for cooperatives. FPOs (Farmer Producer Organisations) have been started to realise the vision of cooperative transformation. To scale up and create cooperatives like Amul, we need funds, social mobilisation, organising and coordinating the farmers and empowering them with the ability to do business and earn money. A seamless technology platform owned by the farmers and all other stakeholders may be the right approach.

Government is a key player: The governments both, state and central, need to enable technology enabled transformation of Indian agriculture. These include formalising the activities related to education, research and development. A clear roadmap with adequate and sustained funding, government and private, and institutional support for development of India specific technologies, bringing them to the market and implementation at farm level. Making clean data accessible to all stakeholders is an important enabler. Enabling industry and start-ups is crucial, with provisions for close interaction with academia, scientists and farming community.

AIML can potentially influence decision making in the entire agriculture cycle: There is a potential for AIML to aid decision making across the entire Agri lifecycle, viz., planning (what to sow), input decisions like fertilizers (when and how much to apply) and credit, crop management (pest control and grading), and harvesting (when to harvest and where to sell), etc. National grand challenges using AIML techniques can be proposed for (1) crop recommendation, (2) yield estimation and crop price prediction, and (3) seamless access to markets. Great potential exists as well for using AI for pest prediction and prevention, for grading and yield estimation, credit assessment and leveraging game theory to design markets attractive to both farmers and consumers. Proactively provide the right quantity of nutrients (micronutrients) at the right time.

Data Governance and Management: There is a need for one main directory as there are too many variations and types even in a single crop. Standardizing all these varieties and documenting them is key. Data exists but it is all siloed out in multiple organisations and entities. Data is not high quality so collecting itself is a problem. The key is data quality, data collection training, and data sources.

Responsible Algorithms: Addressing inequality should be factored into how the model is built. Technology should optimise for all, not farmers alone. There is a need for responsible AI algorithms with fairness, transparency, accountability, and full cognizance of ethical considerations. The algorithms should be explainable.

Key Recommendations

Education and Research: Launch joint research programs between agricultural and engineering institutes; Start academic programs (M.Tech., Ph.D.) programs across institutes to bring together students from agricultural and engineering disciplines; Introduce internship programs in agri-industries and agri-startups for students to get exposure and hands-on experience.

Set up centres of excellence in precision agriculture on the lines of CISTUP (Centre for Infrastructure, Sustainable Transportation, and Urban Planning, IISc set up by the Karnataka Government). In order to promote seamless collaboration among academic institutions, research labs, industry, and startups, set up an interdisciplinary technology innovation hub in digital agriculture on the lines of Technology Innovation Hubs set up under the DST initiative in inter-disciplinary cyber physical systems.

Set up precision agriculture test beds where technologies can be developed and tested – sensor networks, imaging systems, pest control strategies, delivery systems (robotics, drones, etc). To begin with, the following can be set up: two farms – a farmer's field, and a field in an university; two protected agriculture units (polyhouses, green houses) – one in an academic institute and another in an industry.

Recommendations for Farm Mechanization: In the short term, (1) the curriculum of agricultural engineering be enhanced with increased focus on making the outgoing agricultural engineers industry-ready; (2) conduct frequent academia and industry meets to exchange the ideas and develop need-based machinery to increase the level of mechanization; (3) Increase the number of reserved posts for agricultural engineers in the Departments of agriculture from the present level to 30% (4) custom hiring centres may be established at Taluk level along with heavy / special machinery to help farmers; and (5) a national level test certificate for the newly developed machinery may be issued and all the state departments may honour the same for their empanelment of the machinery under subsidy schemes.

In the long-term, (1) establish a separate Department/ Directorate of Agricultural Engineering in every state wherever it is not established so far; (2) data on soil types/ properties in the state may be made available to help the manufacturers to develop machinery suitable to the various soil types; (3) develop crop-specific and multifunctional machinery for different agricultural operations; (4) more assistance and encouragement to be given to the start-ups to attract the young / fresh engineers into the area of agricultural mechanization; and (5) develop energy efficient, autonomous and sensor-based machinery using the latest technological innovations.

Recommendations for Secondary Agriculture: Establish (a) Directorates of Secondary Agriculture in the states (b) rural agro processing industries with high quality and hygienic products (c) an agri-food biotechnology institute similar to the NABI in Karnataka (d) agro processing centers to take up the secondary agriculture activities (e) a quality testing laboratory for value added products (f) food parks, cold storage, etc. Design and develop suitable processing machines for secondary agriculture.

Data Governance and Data Interoperability: The government should take steps to enable seamless translation of agriculture data into valuable Information and to "actionable" insight for being used for various agriculture use cases, requires data-sets to be seamlessly interoperable across data sources and consumers of data (from govt, private sector, startups, research institutes). Currently there is a gap with respect to agriculture data interoperability for seamless integration across applications. Privacy and security issues to be accorded due priority. IUDX (Indian Urban Data Exchange) seems to be a good model to adopt. Data to be made available to AIML researchers to make the algorithms better. A team of experts to be identified for operationalising the policy as soon as possible.

Sandbox and Pilots for High Impact Applications: The Government should facilitate rolling out innovations that leap frog the growth in technology innovations and help solve the key challenges faced by small and marginal farmers. Two important issues to keep in mind are to ensure adoption at farmer level and also to avoid duplication of efforts. There are many use-cases waiting to be taken up: (a) Price and yield prediction for crops (b) Carbon Sequestration - based incentives, possible for sustainable agriculture. (a) Early pest detection (d) crop recommendation (e) seamless access to credit and insurance, etc.

1. Workshop Schedule

Time	Item
9:45-10:00	Networking
10:00-10:05	Welcome and Introduction by Prof. K.B. Umesh, UAS, Bangalore
10:05-10:10	Welcome Address by Prof. Indranil Manna, President, INAE
10:10-10:15	Address by Prof. S. Rajendra Prasad, Vice-Chancellor, UAS, Bangalore
10:15-10:20	Address by Prof. Usha Vijayraghavan, Dean, Division of Biological Sciences, IISc
10:20-10:25	Address by Dr. B N Srinivasa Murthy, Director, ICAR-IIHR, Bangalore
10;25-10.30	Workshop Expectations by Prof. V K Aatre, Chairman, INAE, Bangalore Chapter
10:30 -10:50	Chief Guest's Address by Dr.S.Ayyappan, Chairman, KSTA Bangalore & Former Director General, ICAR .
10:50-10:55	Plenary Session: Introduction by Dr. Nipun Mehrotra, Founder, The Agri Collaboratory, Bangalore
10:55-11:20	Keynote Talk: Precision Agriculture by Prof. M.S. Sheshshayee, UAS, Bangalore
11:20-11:45	Keynote Talk: Artificial Intelligence and Machine Learning (AIML) in Agriculture by Prof. Y. Narahari, IISc, Bangalore
11:45-12:10	Keynote Talk: Farm Mechanization by Dr. C.R. Mehta, Director, ICAR- CIAE, Bhopal
12:10-12:35	Keynote Talk: Secondary Agriculture by Prof. Chindi Vasudevappa, Vice Chancellor, NIFTEM, Kundli, Haryana.
12:35-13:00	Industry and Academia Interface by Mr. S. Sivakumar, Group-Head, Agri and IT Businesses, ITC Limited
13:00- 14:00	LUNCH BREAK
14:00-15:30	**Parallel Thematic Sessions** Precision Agriculture: Prof. Jaywant Arakeri, Professor, Mechanical Engineering, IISc, Bangalore Farm Mechanization: Dr. G. Senthil Kumaran, Principal Scientist, IIHR, Bangalore Secondary Agriculture: Dr. C.T. Ramachandra, Associate Professor, University of Agricultural Sciences, Bangalore AIML in Agriculture: Mr. Ravi Trivedi, Officer on Special Duty, Agriculture, Indian Administrative Fellowship, Government of Karnataka
15:45-16:15	Presentation by moderators. Discussion and Feedback.
16:15-16:45	Valedictory Session: Plenary Talk by Mr. Shivaraju Boraiah, Additional Director of Agriculture, Govt. of Karnataka
16:45-16:55	Concluding Remarks by Prof. V.K. Aatre, Chairman, INAE Bangalore Chapter
16:55-17:00	Vote of Thanks by Mr. V. V. R. Sastry, Former CMD, BEL, Bangalore

2. Plenary Session, Keynotes Session, Valedictory Session

The day-long workshop was in the form of a series of discussions among experts from academic, research, and government institutes, industry, and start-ups. The workshop began with welcome addresses by Prof. K. B. Umesh, UAS, Bangalore and Prof. Indranil Manna, President, INAE.

The workshop expectations and outcomes were outlined by Prof. V. K. Aatre, Chairman, INAE Bangalore Chapter. The chief guest, Prof. S. Ayyappan, former Director General, ICAR and Chairman, Karnataka Science and Technology Association, spoke about smart farming and the need for repositioning agriculture as everyone's business. Additionally, a diverse range of experts shared experiences and provided action-oriented recommendations in modern agricultural technologies, through panels and keynotes across four streams – Precision Agriculture, Farm Mechanization, Secondary Agriculture, AI-ML in Agriculture, and Industry and Academia Collaboration. The workshop plenary was moderated by Mr. Nipun Mehrotra, Founder and CEO, The Agri Collaboratory.

Precision Agriculture | **Farm Mechanization** | **Secondary Agriculture** | **AI/ML in Agriculture** | **Industry and Academia Interface**

These five areas were chosen for keynote talks as they are fundamental to accomplish the goals set by our Honourable Prime Minister towards doubling the income of farmers and reaching a state of AtmaNirbhar Bharat.

Precision Agriculture: The AAA sectors (Agriculture, Animal Husbandry, and Aquatic) are key drivers for self-sustenance in food production and can benefit from using technology and data precisely to control application of inputs and decision making. As Prof. M.S. Sheshshayee highlighted in his keynote, precision farming allows us to manage availability and usage efficiency of constrained resources (e.g. water) by leveraging sensors and data to identify symptoms.

Farm Mechanization: A shift from "tractorisation to mechanization" is essential as per Dr. C.R. Mehta. Marginal land holdings and labour shortage imply that affordability, equipment size, and minimal human intervention are important considerations for farm mechanization along with the need to optimize life cycle cost of ownership, down time, drudgery, etc. Developing gender neutral implements and increasing mechanization towards the later stages of the crop lifecycle are also important. Innovative co-op models of ownership and customized hiring of high-end equipment are emerging business models that need to be implemented, along with creating hubs for farm equipment.

Secondary Agriculture: Food surplus does not translate to nutrition sufficiency, leading to rampant malnutrition in rural India. Prof. Chindi Vasudevappa pointed out - "India's food wastage was as much as UK's overall consumption" and the need to maintain quality and safety of both raw produce and processed food are critical. At the same time, losses are very high across all stages: production, storage, processing and packing, distribution, etc. Fortification of foods to address malnutrition, aligning with ODOP (one district one product) model for planning food processing units, and leveraging technology like cold chain, blockchain, drones, etc for improved and auditable food processing are important. Village adoption programs and centers of excellence in agricultural production and food processing need to be designed to bolster the agricultural development in India.

AI/ML in Agriculture: There is a potential for AI/ML to aid decision making across the entire Agri lifecycle, viz., planning (what to sow), input decisions like fertilizers (when and how much to apply) and credit, crop management (pest control and grading), and harvesting (when to harvest and where to sell), etc. Prof. Y. Narahari suggested a governance framework based on FATE (Fairness, Accountability, Transparency, Ethics) and emphasised that data interoperability, standardization, privacy and security guidelines were essential to leverage AI/ML to its full potential. He recommended (1) crop recommendation, (2) yield estimation and crop price prediction, and (3) seamless access to markets using AIML techniques be taken up as national grand challenges.

Industry and Academia Interface: ITC Ltd's Group-Head for Agri and IT Business, Mr. S. Sivakumar highlighted the need for a systems thinking approach and multi-stake holder collaboration between industry and academia to accelerate transformation. Key factors to consider while exploring appropriate technology, and to gain institutional and government support include ensuring:

- relevance at the individual farmer level for easy adoption,
- pragmatic and economic end-to-end solutions that reach farmer, and
- programs need to make at least "business sense or welfare sense."

He emphasized the need for domain expertise, technical knowledge, social sciences, data analytics, and engineering to come together. He highlighted the importance and potential of wide-ranging collaboration using ITC's example of partnering with 24 academic and research institutions; 83 government entities; 82 NGOs for execution; and 45 industry enterprises including 13 Agritech start-ups.

Key Recommendations from Plenary, Keynote, and Valedictory Sessions

The workshop emphasized several holistic, implementable recommendations as next steps in four areas.

Multidisciplinary and Partnership Approach

Most speakers emphasized propagating an approach of co-hosting and co-locating several disciplines to enhance partnerships and multi stakeholder collaboration between domain research, industries, academia, and agri start-up ecosystems which are key to improving innovation. By providing examples of co-location of multiple streams within the campuses at Cornell University, Australian National University, and University of California, Davis, Prof. Usha Vijayraghavan highlighted how Bangalore especially, could catalyse multidisciplinary interactions since the potential partners like IISc, ICAR, IIHR, UAS, are proximally located.

Speakers advised the benefits of this approach, including the ability to examine issues holistically to avoid one policy fix being detrimental to another (for example free electricity leading to unsustainable water consumption; and working on organic farming or natural farming in combination with issues of climate change and water scarcity).

As Prof. Y. Narahari stated, collaborators need to have a mindset of blue-sky research coupled with start-up type enthusiasm and innovation. Start-ups could help in engineering solutions partnering with domain players. The future of Indian farming is diversely spread among the areas of horticulture, agroforestry, livestock and field crops. Prof. M.S. Sheshshayee alluded to the premise that management responses need to go beyond biological tasks and be collaborative with engineering and technology for doing the right things at the right place and at the right time. Multidisciplinary courses like M.Tech. in Agricultural Engineering can develop required skills besides integrating engineering domains with agricultural disciplines - for example, a biomedical sciences model could be replicated in agricultural practices.

For developing partnership structures, Mr. S. Sivakumar proposed a "collaboration framework" - advising that "transformation" must benefit everyone and that "innovation, incentives, investments and institutions need to converge". For partnering to be successful, it is important to complete all the groundwork on scope and get an alignment on the objectives upfront. He proposed a three-dimensional framework for success:

- **Depth** of engagement (degree of immersion and support)
- **Width** (broad engagement across faculty + internships + curriculum development)
- **Length** (alignment duration, conflict resolution)

Moreover, subject knowledge and skill building are critical: early stage and PoC funding are required to encourage innovation and entrepreneurship; incubation infrastructure needs to be developed in PPP mode; and proposals may be made to government agencies to provide incentives and concessions for skill development and entrepreneurship.

Applying Engineering and Scientific Disciplines for the Benefit of Agriculture

Agriculture is often seen only as a societal concern and not an engineering problem and this theme was echoed by several speakers through the workshop. Prof. V. K. Aatre encouraged the engineering and scientific communities to come together to help agriculture. As Prof. Usha Vijayraghavan explained, genome science and genome engineering have the potential to address real problems in the Indian ecosystem which has its own uniqueness with diversity and nature of small holdings. Technology will be a tremendous facilitator to access markets, inputs, data, advisory, loans and insurance, holistic analytics by integrating agri-data with metrological and soil health data, remote sensing and proximate sensing to evaluate soil indices. The ongoing humanitarian crises with respect to malnutrition and agricultural production needs to be addressed by leveraging 21st century engineering tools. In fact, technology should not just be "used" - instead it should be exploited aggressively for the advantage of the farmer.

Dr. B. N. Srinivasa Murthy suggested using technological solutions like decision support systems, since managing food security with climate change remains a key challenge for science and technology. Smart decision support systems aid farmers with analyzing critical factors: For example, what should a farmer focus on: Agriculture? Horticulture? Dairy? or Fisheries?

In Prof. S. Ayyappan's words, technology should transform Indian farmers to agripreneurs. Additionally, platforms are needed to bring several disparate issues together like the impact of climate change, leveraging data to analyze farming at all stages, stress of abiotic and biotic factors, disaster management and insurance, etc. While innovations are growing at the farmer level, platforms need to help on-board innovation and scale it, develop "farm to fork" systems, integrate learning, usage and adoption of fertilizers, intervene crop-residue burning, and initiate programs for agri-tourism. There is also a need to subsidize the use of technology for agriculture.

A big opportunity for manifesting science and engineering for agriculture is in food processing with post-harvest losses ~Rs. 90,000 crores, including input water wastage (3500 litres/kg of rice, 1500 litres/kg of wheat), there is a pressing need for better technology for processing, value addition, food safety, and quality assurance. Another is increasing mechanization levels - currently inconsistent across crops (high in staples, low in cash crops), and across the crop cycle (highest in sowing and in the early stages, and low during the later stages) and addressing land terrain limitations for high power and weight machines, low power availability and spatial variation in cropping systems.

Great potential exists as well for using AI for pest prediction and prevention, for grading and yield estimation, credit assessment and leveraging game theory to design markets attractive to both farmers and consumers. Although there are roadblocks to integrating digital technology with agriculture in terms of accessibility and adaptability, farmer- centric solutions are important and hence using social sciences within the scope of technology is much needed.

Attracting Youth towards Agriculture

Initiatives need to be taken to attract fresh talent towards Agriculture, highlighting it as an attractive career option for India's youth. Given how younger farmers are receptive to technology, skill development coupled with the energy of the youth can go a long way into scaling the agricultural ecosystem in India.

Prof. S. Ayyappan suggested promoting agri-oriented skill and career development in India can help increase the involvement of youth. Specialized schools and vocational programs in agri-sciences, and capsules of agriculture-related syllabus should be introduced at the high school level, along with distance learning for young farmers. Women student participation should also be encouraged, amidst the rise of regenerative agriculture with the goal of reaching zero waste by 2030, through education and capacity building. Ultimately, energy should be harnessed for community participation, resource recovery centers for waste management, and empowered learning for greater reach and holistic development of the youth.

With 50% of Indian Agri start-ups based in Karnataka, their knowledge and practical experience can help strengthen school programs and motivate the energetic minds of the youth, framing an agri-entrepreneurship mindset early on.

Government Involvement

The Government can help provide a collaborative and interdisciplinary focus across the Agri ecosystem along with consistent data sharing policies. Regular sessions with the Agri start-up ecosystem will help in building deeper partnerships and enable better policy development. A centralized system rather than a state specific system for approval of machinery is a major recommendation. Mr. Shivaraju Boraiah, Additional Director of Agriculture, Govt. of Karnataka explained that Karnataka has established a good balance between private firms and the government, with the open data policy. He mentioned several successful agricultural projects implemented by the Govt. of Karnataka.

- Establishment of a Secondary Agriculture directorate
- Supporting farmers through an integrated farming system: Project worth 76 Cr implemented across gram panchayats
- Data visibility using FRUITS application
- Samrakshane Portal: Completely integrated crop insurance portal of Karnataka
- Kutumba Program: Data on farmer's each family member is being captured
- High transparency: 95% of payments are routed through Direct Benefit Transfer.

Conclusion

There will be a challenge to feed the world in the next 25 years, primarily due to population growth, decrease in arable land, impact of climate change on soil and ecosystem, and demand for water management. Interdisciplinary, cross-disciplinary, trans-disciplinary focus is critical to solve agricultural problems. These problems should be addressed collaboratively to enable India to become self-sustainable and become a provider of Agri-Tech solutions globally. Agriculture is one of the most complex and unique engineering challenges and preservation and post-harvest technology offer a good scope for integrating engineering and agriculture.

As aptly summed up by Prof. S. Rajendra Prasad, the acceptance for Agri Technology is growing amongst small and marginal farmers who are adapting to digital modes, thanks to smartphones, access to the internet, and improved digital literacy. Hence, there is a compelling reason to support farmers to switch to smart farming. Issues like digitization, on-line buying, mandi pricing prediction, pre-harvest and post-harvest fertilizer decisions have to be addressed.

Supply chain for agriculture was resilient during COVID-19 - but as agriculture is everyone's business, it is the right time for science, technology, and agriculture to join hands to buttress each other. This workshop established a platform between different disciplines debating integrated issues and it's recommended this be made an annual session. As Mr. Nipun Mehrotra suggested, it is time to put an operational discipline in tracking the several recommendations and implement a few quickly!

3. Panel on Precision Agriculture

Introduction

In precision agriculture, the aim is to use optimum amounts of inputs – water, nutrients, pesticides, etc. – at the optimum times to maximise productivity. The most common and traditional component of precision agriculture is drip irrigation, where water is fed to a plant in the form of drops, typically at a few litres per hour. A variant of drip irrigation is fertigation, where nutrients are mixed with the water. There has been increasing use of sensors to identify deficiencies (e.g., moisture in soils and nutrient levels in plants) and diseases so that appropriate action may be taken. The sensing may be from point sensors, to measure soil moisture, temperature, etc., or from imaging, using ground, robot or drone-mounted systems or from satellites to obtain information on plant health, nutrient deficiency, etc. Targeted delivery of fertilisers and pesticides is increasingly possible using this data and automated or semi-automated delivery systems mounted on tractors or autonomous vehicles. There is a enormous scope to develop new technologies and algorithms for precision agriculture applications that would require close interaction among agricultural scientists, mechanical, electrical and computer engineers, and industry. India has unique challenges for developing these technologies given the small landholdings, and huge diversity in climatic and soil conditions and cropping patterns. The discussion in this session was on various issues related to precision agriculture as applicable to India.

The keynote was given by Prof. M S Sheshshayee of the University of Agricultural Sciences, Bangalore. He presented the various facets of precision agriculture including the latest technologies, and the work that is being done in India.

List of Panelists

1) Prof. Jaywant H Arakeri, (Moderator), Mechanical Engineering, IISc, Bangalore jaywant@iisc.ac.in
2) Dr. Prasanna Bhat, Bayer Crop Sciences, Bangalore: prasanna.bhat@bayer.com
3) Dr. V C Patil, ex-UAS, Dharwad. vcpatilksu@gmail.com
4) Dr. Rabi Sahoo, IARI, New Delhi, rabi.sahoo@icar.gov.in
5) Prof M S Sheshshayee, UAS, Bangalore
6) Prof K R Sreenivas, EMU, JNCASR. krs@jncasr.ac.in,
7) Dr. Kesavan Subaharan, ICAR – NBAIR. subaharan_70@yahoo.com

Summary of Panel Discussion

The moderator briefly introduced the subject of precision agriculture, its different components, the scope of the discussion and the nature of recommendations that are expected from the session. Then he requested each of the moderators to give their remarks.

Dr. Subaharan:

- Now that food sufficiency has been achieved it is important to concentrate on quality, pesticide-free produce.
- Described use of non-pesticide pest control using attractants, repellents and pheromones and establishment of companies in India manufacturing products that use these techniques.
- Understanding of trophic interaction between plants and insects, identification of volatiles necessary to develop these methods.
- Develop sensors for detecting signals from plants
- Any technology that is produced should be as inexpensive as possible to penetrate deep into the market.
- Precision agriculture is an assembly line; no individual technology can be a stand-alone component.

Prof Sreenivas:

- Need to look into sensors and engineering technology for both open field and protected agriculture.
- Use sensors to monitor soil health and environmental conditions, including weather stations, imaging technologies, wireless sensor networks for gathering the data and storing it in a way that can be used with Artificial Intelligence and Machine Learning tools.
- Do computational fluid dynamics (CFD) simulations using data from weather stations and satellites for forecasting weather at local level (few kilometers) over short times (days).
- Listed the special circumstances of protected agriculture, for example, in poly houses, that require technologies like micro-climate monitoring and control.
- For high-value crops, for breeding requirements, the cost may not be the main criteria but achieving the required conditions for optimum growth is.
- Technology and sensors that we develop needs to be modular, rugged and it should be scalable; modular in the sense that they can be used for multiple applications: small scale fields, for breeding, for protected agriculture, etc.
- Need expertise from various fields of engineering, like mechanical, computer science, electronics, civil engineering, and satellite image analysis.
- Agricultural and engineering students need to be brought together for masters or doctoral degree programs to foster sustained collaboration between engineering and agricultural sciences.

Dr Bhat:

- In the industry, precision agriculture is being practised currently for breeding, research and design of products.
- Use toolboxes that use data from satellites, drones, and sensors to give information on crop health and advice on interventions like spraying. Satellite imagery data can be used to estimate crop acreages and potential market areas for specific crop seeds and chemicals.
- Development of prescriptive engines that use precision genomics and data science, including Al, ML-based algorithms to predict emergence, germination issues and mitigate crop-related problems. AI/ML is also used in optimizing seed and chemical operations and testing footprints.
- Use farm machinery fitted with sensors to assess soil type and soil health and assess water and nutrients status that indicate current plant needs.
- Cell phone-based prescriptions on the appropriate variety to be grown in a specific area depending on the climatic and soil parameters.
- Mentioned about a trial near Hyderabad with drone-based insecticide application in a rice farm.
- Precision agriculture especially has an essential role for high-value crops, off-season production, and breeding.
- Interaction required from partners from industry, academia, R&D institutes, and NGOs.

Dr Sahoo:

- Spoke about the role of imaging (visual, IR and hyperspectral), which could be from satellites or from ground level and drone-based systems, in identifying water stress, nutrient deficiencies and disease in plants.
- IARI is using the expertise of the different institutes, organisations working under different domains: soil, crop health, post-harvest analysis, cash crops, climate-change resilient crops
- The knowledge base that is developed can be put on the servers and communication established through the mobile network,

- We have a national-level initiative on network programs and precision agriculture addressing some of these critical issues.

Dr Patil:

- An agriculture scientist, who has become a full-time farmer; he identified ground-level problems, including the uncertainty of markets, the need for availability and use of satellite-based information and weather data and predictions that could help farmers make decisions, for example, whether to spray or irrigate on a particular day.
- Need downscaling of recommendations and high-end technologies to suit local individual farm level requirement. This is a difficult but important task.
- Precision agriculture can be developed for high-value crops and in protected cultivation, to begin with. Once the technology becomes cheap and scalable, we can move to the low-value and food crops.
- To do this integration, we need to fill gaps between engineering and agricultural sciences and find a mechanism for collaboration between experts from engineering sciences, space sciences and agriculture sciences. We cannot develop these technologies in isolation without consulting the farmer; he is the main stakeholder.
- We need to collaborate with space scientists to assess the spatial variability, so once we have together, then we will be able to do an excellent job for the benefit of farmers.
- For farmers, profitability, sustainability, increase in production and income are important. So, the technology needs to be cost-effective.
- Need to build an end-to-end supply chain system, best example being sugar cane. Sugar cane farmers across the country are happy because there is a perfect supply chain system in place; that system is not present for other crops, making them unviable.

Comments from Participants

The important ones are included below.

- Need to think of scale-independent precision agriculture, and for successfully involving farmers as core designers, we must showcase the right technologies.
- Need change of policy so that supply-demand balance is maintained, improve the information flow in our system and improve connectivity.
- SMART farming = "Scientific, Marketable, Acceptable, Reliable and Time-saving technologies"
- Design process needs to be adopted, where specific problems are clearly stated, leading to cost-effective solutions that are likely to be innovative as well.

Technological Challenges and Obstacles to Implement Precision Agriculture in India

- Small landholdings; huge diversity in climatic and soil conditions and in cropping patterns; skilled labour shortage.
- Precision agriculture is highly interdisciplinary, and there is huge scope and need for collaboration and close interaction among agricultural scientists, mechanical, electrical and computer engineers and industry to develop precision agriculture technologies. But India does not have institutes that have experts in all these disciplines in one place, thus requiring collaboration across institutes and labs.
- Very few farmer usable solutions currently available in precision agriculture.
- Even the simplest and most common precision agriculture tool, drip irrigation, has problems of clogging, degradation with time.

Precision Agriculture: Recommendations

Education and Research

1. Joint research programs between agricultural and engineering institutes
2. Start academic programs (M.Tech., Ph.D.) programs across institutes to bring together students from agricultural and engineering disciplines
3. Internship programs in agri-industries, focussing on precision agriculture technologies for Masters/PhD students to get exposure and hands-on experience.
4. Setting up research centres in precision agriculture. An example is CISTUP, set up by the Karnataka Government in IISc for urban infrastructure.

Development

1. Undertake activities in focussed areas of precision agriculture for India specific conditions:
   - Fundamental research on different aspects (movement of fertilizers, pesticides in soil, absorption of pesticides, drone imaging and spraying etc)
   - Development of precision agriculture specific sensing systems: temperature, humidity, light, imaging, wireless sensor networks and sampling tools for pest detection & soil health.
   - Development of precision agriculture technologies – water & nutrient delivery systems, mitigating hardwater problems, AI/ML technologies, multispectral image analysis, sensor plant health/stress, nutrition, non-chemical-based pest and disease management.

2. Precision agriculture may be developed for high-value crops and protected agriculture which is more economically viable; there is room for development of new technologies – imaging, sensing, delivery systems, robotic systems – that can be taken to open-field agriculture. Some target commercial crops: Tea, Coffee, Sugarcane, Cotton, Grape. Identify more crops where precision agriculture techniques could act as catalyst for increasing the income of farmers.

3. Encouraging Public-Private partnering ecosystem for quick scale-up of technologies. Involve established companies and start-ups.

Services for Farmers

Provide information on weather (from satellites, weather stations, forecasts) markets, prices on smart phones.

1. Enable platforms and forums to make available experts' advice on specific problems related to crops: irrigation scheduling, nutrition management, pest and disease control.
2. Fund farmers to visit learning centres where different aspects of precision agriculture is are being practised.
3. Uberization of precision agriculture technologies for large scale adoption in farming. Companies own the high-technology machinery and provide services like spraying, de-weeding, etc

Setting up of Test Beds

Set up test beds where technologies can be developed and tested – sensor network, imaging systems, pest control strategies, delivery systems (robotic, drone etc). To begin with the following can be set up:

- Select two farms – a farmer's field, and a field in an university
- Select two protected agriculture units (polyhouses, green houses) – one in an academic institute and another in an industry

Role of Government and Industry

The government both, state and central, need to enable some of the activities listed above. These include formalising the activities related to education, research and development. A clear roadmap with adequate and sustained funding, government and private, and institutional support for development of India specific technologies, bringing them to the market and implementation at farm level. Enabling industry and start-ups would be crucial, with provisions for close interaction with academia, scientists and farming community.

4. Panel on Farm Mechanization

Farm mechanization is the use of tools and machinery in different field operations in the production system of agricultural crops. It helps to reduce the drudgery of the agricultural labourers caused by awkward postures, repetitive body movements, and extreme environmental conditions.

Due to the migration of labourers from the villages to cities in search of better life earnings, shortage of labour for agricultural operations in the villages is a major problem. Even the available unemployed youth in the villages are not interested or attracted towards agriculture. So the agricultural operations get delayed in crucial periods such as rainy seasons, during heavy demand situations, and at the critical stage of harvesting.

The availability of tractor power is 16 tractors per 1000 ha in comparison to 19 tractors in the rest of the world. This leads to 2kW of power availability per ha in India and helps in mechanising agricultural operations to the level of only 40 to 50 percent.

The Government of India is trying to improve the mechanization level through subsidies, establishing custom hiring centres under its programmes like Sub-Mission on Agricultural Mechanization. There are indigenous tools and machinery developed under National Agricultural Research System and by the private machinery manufacturers. If needed, machinery can be imported and modified to Indian conditions.

Under these circumstances, it is pertinent to discuss the present status of mechanization in our country, its constraints, issues and provide recommendations to improve the level of mechanization. Hence, the following panelists representing academia, manufacturers, start-ups and state departments were invited to give their views and discuss the problems of various stakeholders. Around 50 different stakeholders attended the session and participated in the discussion. The following important recommendations emerged after the discussion in this session.

Details of Panel Session

Moderator: Dr. G. Senthil Kumaran, Principal Scientist, ICAR-IIHR, Bengaluru

Panelists:

Dr. Veerangouda, Registrar, UAS, Raichur. Professor in Agricultural Engineering having more than 30 years of experience in teaching and research. Guided many M.Tech. and Ph.D students in agricultural Engineering in developing Agricultural Machinery. Received awards for his professional achievements.

Mr. S.V. Raju, Chairman, Agricultural Machinery Manufacturers Association, India: A B.Sc (Ag) graduate from a farming family. He is Director of five agricultural machinery manufacturing companies and apart from using his own designs has successfully adopted designs from research institutes.

Mr. A. Rammohan, Executive Vice President and Business Head, TAFE, Chennai: A mechanical engineer with MBA degree working as Executive Vice President and Business Head (Application Business Unit), TAFE, Chennai. One of the largest tractor manufacturers and most popular brand of tractors in India.

Mr. Manesh Jain, CEO, Flo Mobility, Bangalore: He is founder and CEO of Flo mobility, Bengaluru, a start-up working towards enabling autonomous navigation of vehicles and equipment used in farming. Manesh carries 16+ years of experience working across industries with last 10+ years being involved in running startups. His previous startup was acquired by Reliance Jio. Passionate about green energy.

Mr. N. Unnikrishnan, Superintending Engr, Agricultural Engineering Dept., Coimbatore: He is a member in various technical committees of the department. He has more than 38 years service in different positions in the department handling various development schemes of the state, World Bank schemes to disseminate the agricultural engineering technologies among farmers and entrepreneurs and overall development of the implementing areas.

Recommendations for the Short-Term:

1. The curriculum of agricultural engineering may focus on the need of the industries to make the outgoing Agricultural Engineers industry-ready.

2. Frequent academia and industry meets should be conducted to exchange the ideas and develop need-based machinery to increase the level of mechanization

3. Increase the reservation of posts from 15% to 30% to the Agricultural Engineers in the Department of Agriculture, Govt. of Karnataka

4. Custom hiring centres may be established at Taluk level along with heavy / special machinery to help farmers

5. A national level test certificate for the newly developed machinery may be issued and all the state departments may honour the same for their empanelment of the machinery under subsidy schemes

Recommendations for the Long-Term:

6. Establishment of a separate Department/ Directorate of Agricultural Engineering in every state wherever it is not established so far

7. Data on soil types/ properties of the state may be developed to help the manufacturers to develop machinery suitable for various soil types

8. Develop crop specific and multifunctional machinery for different agricultural operations

9. More assistance and encouragement should be given to the start-ups to attract the young / fresh engineers from different disciplines to contribute to agricultural mechanization

10. Energy efficient, autonomous and sensor-based machinery may be developed to meet future challenges.

5. Panel on Secondary Agriculture

Secondary Agriculture includes all practices and process which add value to primary agricultural commodities by using efficient technologies, market information, and consumer preference. The term secondary has a bearing on climate change adaptation and its mitigation, small farm viability and profitability, food security, nutrition, sustainable utilisation of natural resources, and optimal usage of produce from primary agriculture and farm incomes. In other words, promoting secondary agriculture has implications for attaining sustainable development goals, which aim to connect primary, secondary and tertiary sectors by using slack/idle factors of production, such as land and labor—contributing to primary agriculture production, capturing value in primary agricultural activities, and generating additional income at the enterprise level.

The secondary agriculture sector is regarded as a sunrise sector for the Indian economy as it has a major role to play in employment generation, poverty alleviation, and product diversification. Secondary agriculture is one of the ways to achieve holistic and inclusive development of farmers, forest dwellers, and cattle owners.

Secondary Agriculture plays a very important role after harvesting: it is known by several names such as Post-harvest engineering/technology, value addition, food processing, etc.

Importance of Secondary Agriculture

Secondary agriculture, as is defined, can help drive the growth of primary agriculture, and three avenues have been identified that adequately help utilise capital, human resources, technology, organizational capabilities and risk management:

1. Type A: Value-addition to primary agriculture production systems

2. Type B: Alternative enterprises, but linked to rural off-farm activities

3. Type C: Enterprises that thrive on crop residues and waste materials of primary agriculture

Type A can be achieved by improving livelihood enhancement action plans that are implemented by farmer-based/community-based organizations. Linking farmers with the market through aggregation and assaying/grading of agricultural produce can help them in value enhancement and appropriation. Farmer cooperatives, cluster farming, financial literacy, marketing skills are important to build this avenue.

Type B is based on utilization of alternative enterprises to primary agriculture but is associated with rural off-farm activities. For example, poultry, bee-keeping, duck farming and livestock management are off-farm enterprises that can be promoted as part of integrated farming system. Integrated farming can hedge farm risk in the period of crop failure or ease out the seasonality in the stream of cash flows.

Type C are such enterprises that strive on crop residues, or by-products of primary agriculture. For example, after recovering sugar from the cane, the cane can be used as bagasse for molasses production. Similarly, cotton stalk and seed (after ginning) can be used for de-oiled cake preparation or utilized in the secondary/tertiary sector.

Details of the Panel Session

The objectives of the session were: (1) To share the experiences in modern secondary agricultural technologies and (2) To understand implementation challenges, identify solutions and recommend future strategies in secondary agriculture

Moderator: Dr. C T Ramachandra, Associate Professor and Head, Department of Processing and Food Engineering, College of Agricultural Engineering, University of Agricultural Sciences, GKVK, Bangalore

Panelists

Dr. V. Palanimuthu, Special Officer, College of Agricultural Engineering, UAS, Bangalore: More than 30 years of experience in the field of Post-Harvest Engineering and Technology and Secondary Agriculture. He has developed several machines and technologies useful to the farming community and food processing industries.

Dr. Ashwani Pareek, Executive Director, NABI, Mohali, Punjab: A prominent plant biologist and educator noted chiefly for his contribution in the area of plant Molecular Biology and Biotechnology. He is currently working as Professor of Plant Molecular Biology and Biotechnology at the School of Life Sciences, JNU, New Delhi, He has keen interest in understanding the physiological and molecular adaptations in xero-halophytic

plants and development of transgenic rice plants with enhanced tolerance towards multiple abiotic stresses including salinity and drought.

Dr. Sharanagouda Hiregoudar, Associate Professor and Head, Centre for Nanotechnology, University of Agricultural Sciences, Raichur: He is a prominent scientist in the field of nanotechnology, noted chiefly for his contribution in the area of nano technology applications for secondary agriculture.

Dr. Anil M Naik, Founder, Innovative Food Consultants, Tumkur: He has more than 20 years of experience in food safety systems and quality assurance. He is instrumental in establishing several food processing industries in India and Abroad.

Mr. Prasanna Gudi, Assistant Manager R & D Coffee Processing and Quality at Harley Plantation Research Institute, Sakleshpur: He is an alumnus of Coffee Board of India. He is an innovative researcher in coffee processing and developed several technologies like coffee leaf tea, green coffee, blossom coffee, etc.

Recommendations for Secondary Agriculture

1. Establishment of Directorate of Secondary Agriculture in Government of Karnataka
2. Establishment of rural agro-processing industries with high quality and hygiene.
3. Establishment of agri-food biotechnology institute similar to the NABI in Karnataka
4. Establishment of agro processing centers to take up the secondary agriculture activities
5. Establishment of quality testing laboratory for value added products
6. Establishment of food parks, cold storage, etc.
7. Design and development of suitable processing machines for secondary agriculture.

6. Panel on Artificial Intelligence and Machine Learning for Technology Enabled Transformation in Agriculture

Moderator (M): Ravi Trivedi, Officer on Special Duty, Agriculture, Indian Administrative Fellowship

Panelists (P):

P1 : Nipun Mehrotra, Founder, Agri Collaboratory

P2 : Sanjiv Kumar Jha, Solution Architect, Amazon

P3: Trilochan Shastry, Founder CCD NGO (working on farmer cooperatives) and Professor, IIM-Bangalore

P4 : Subrat Panda, CTO, Agnext

P5 : Aadith Moorthy, CEO, Boomitra

Opening Remarks by Moderator: Overview of problems that can be solved using AIML and emerging technologies. Examples include: pest control, price and yield prediction of a particular crop, traceability of product and seed.

Given the amount of data being produced by precision farming and digitization trends, we can learn much from supervised as well as unsupervised learning models to uncover interesting trends and connections hitherto not thought of.

How can AI/ML be a game changer and enable a leapfrog of the Agriculture industry?

Panelist Introductions

P1 : Before AI, Collaboration-Innovation and Execution

P2 : Data Science for Social Good : Smart Agriculture, Agri Stack, and Innovation pod

P3 : There is money in food but no money in agriculture

P4 : Company mission - Quality food for billions : Trifecta of Data, IOT, and AI.

P5 : How to improve farmer's income enabled by AI

DISCUSSION AND QUESTIONS

Q) Is AI just a fad or a silver bullet (simple and magical solution to all problems)?

Prof Narahari in his keynote talk had shared that we are currently at the peak of hype cycle for AI/ML technologies in Agriculture, and, unless we quickly address and resolve the key challenges, we will be end up in a trough of disillusionment. In that context, do you think AI is just a fad or a silver bullet?

P5 : 'We shouldn't come up with great technology and push it onto the farmer; instead, we should identify the pain points of the farmer and then build the AI based algorithms and technology that will help alleviate the 'pain'. AI is not a silver bullet. It should only be used to solve realistic problems where it can add value.

P2 : AI is unavoidable. We have to learn where and how to harness it. It is technology that opens up attractive possibilities. You do not go putting a weather station in every farm to optimise the farm operations. The scale is important.

Q) What are the moonshots of these emerging technologies?

P4 : Detect disease well ahead of time. Proactively provide the right quantity of nutrients (micronutrients) at the right time.

P2 : Farming as a service- this is only possible through AIML. Subscribe to a service to get visibility of farming lifecycle – pest control, optimal fertilizer application, water management, soil health monitoring, planning for harvest, etc.

P1 : AI is a foundation layer and broad technology; it can tackle any problem; sustainability is important. Two critical use-cases are: access to credit (use data to solve the collateral problem) and access to market (fair price).

Q) What does it take for grassroot adoption?

P1: Solution should ultimately target farmers. Institutions like UAS, NABARD and other agri institutions are only the intermediaries. It is a mission failure if farmers do not get direct access to the technology benefits.

P5 : Barriers to entry should be zero or negative. An example is AI for credit in fintech and agri fintech. Even though the farmer does not directly use AI, he uses an AI enabled service. The real moonshot is transform AI advances to services that are simple, explainable, and farmer-friendly.

P3 : The Government has not been able to convince farmers about MSP in Punjab. Many tall claims have been made but actual material benefits and convincing the farmers are most important. Simple material improvements like

cheaper/better fertilizer, better water management, and better nutrients go a long way to improve the trust of the farmer in technology. China doesn't use AI but does much better with lower fertilizer than India even though its cultivated land area is lower. Use whatever AI technology that is appropriate, solve simple pain-points like water, credit, and market access.

Q) Challenges, solutions and governance structures for Data?

P4 : Need for one main directory as there are too many variations and types even for a single crop. Standardizing all these varieties and documenting them is key.

P5 : Data exists but it is all siloed out in multiple organisations and entities. Sometimes the names are different. Data is not high quality so collecting itself is a problem. The key is data quality, data collection training, and data sources.

P1 :11 different varieties of Banaganipalli mango. If all are sold at a standardized rate, then the price advantage is lost to many farmers.

P3: Is data for the farmer or farmer for data? Data is important but is not the silver bullet. The simple thing is that people with solutions should get out of the way and let the farmers solve it themselves. Study the AMUL model that is right in front of us. We don't need to look for AI and data for everything.

Q) Is only maximising utility for farmers the right question? Should we look at only the economic aspect? Is systemic thinking required?

P4 : Moisture is the biggest killer of produce. For a farmer, it may be a small loss but the supply chain loses out, so systemic thinking is necessary.

P5 : Addressing inequality should be factored into how the model is built. AI should optimise for all, not farmers alone. There is a need for responsible AI algorithms with fairness, transparency, and accountability.

OTHER POINTS AND QUESTIONS

- New income routes should be explored - for example carbon sequestration: gateway for farmers to become more sustainable.
- To scale up the cooperatives to be like AMUL we need funds, social mobilization, organising and coordinating the farmers and empowering them with the ability to do business and earn money.
- The math about yield and market price estimation can be done but the most important thing is validation on the ground. Thus, theoretical solutions are not complete unless they are tested against data
- Training of farmers is very important for grassroot adoption. Social media will play a big role here.

Recommendations

Data Governance and Data Interoperability: The government could take steps to enable seamless translation of agriculture data into valuable information and to obtain "actionable" insights that can be used for proposing solutions for various agricultural use cases. This requires datasets to be seamlessly interoperable across data sources and consumers of data (from govt, private sector, startups, research institutes). Currently there is a gap with respect to agriculture data interoperability for seamless integration across applications. Privacy and security issues need to be accorded due priority. IUDX (Indian Urban Data Exchange) seems to be a good model to adopt. Data to be made available to AIML researchers to make the algorithms better. A team of experts needs to be identified for operationalising the policy as soon as possible.

Sandbox and Pilots for High Impact Applications: The Government should facilitate rolling out innovations that leap frog the growth in technology innovations and help solve the key challenges faced by small and marginal farmers. Two important issues to keep in mind are to ensure adoption at farmer level and also to avoid duplication of efforts. There are many use-cases waiting to be taken up: (a) Price and yield prediction for crops (b) Carbon Sequestration - based incentives, possible for sustainable agriculture. (a) Early pest detection (d) crop recommendation (e) seamless access to credit and insurance, etc.

Enable seamless collaboration: The Government should enable intense collaboration between Agri institutions, engineering institutions, start-ups, and industry in developing and deploying the best AIML solutions for problems that make a difference to the farmers and consumers. This could be promoted by an interdisciplinary technology innovation hub in AIML Enabled Digital Agriculture on the lines of Technology Innovation Hubs set up under the DST initiative in inter-disciplinary cyber physical systems.

INAE Chennai Local Chapter

Webinar on "An R&D Road Map for Indian eMobility -2022 to 2030" on 19th February 2022

INAE Chennai chapter organized a webinar titled "An R&D Road Map for Indian eMobility -2022 to 2030" on Saturday, 19th February 2022, at 5.00 PM. About 40 people attended the webinar. Apart from the speaker, there were three panelists – Prof. S. Narayanan, the president of INAE Chennai chapter, Prof. Shankar Ram, a member of the Executive Council of INAE Chennai chapter and also the moderator and Prof. Nandita DasGupta, the secretary of INAE Chennai chapter.

Prof. Narayanan initiated the proceedings by welcoming the guests. He then introduced the speaker Mr Karthick Athmanathan, who is a Senior VP at Ashok Leyland and also a Professor of Practice at IIT Madras. In his talk, Prof. Athmanathan gave a comprehensive picture of the technology status and roadmap of e-mobility in India as well as in the global context. He projected both short-term and long-term roadmap for the different segments – e-rickshaw, e-cars, LCVs, buses and trucks and also discussed the problems/potential in each sector. He also discussed schemes and tools to enable this RoadMap and pointed out certain segments where India can be a world leader. He said that all sectors namely, Industry, Academia, and Government should work together to make this happen.

Prof. Karthick Athmanathan also mentioned in his lecture that the main points presented and possible follow up actions suggested requiring policy decisions from the Government may be brought to the notice of the concerned ministry. Prof. Shankar Ram was the moderator. He collated the questions raised by the audience and presented them to the speaker at the end of the talk. The Q & A session was very interesting and interactive. Finally, Prof. Nandita DasGupta proposed the vote of thanks.

INAE Mumbai Local Chapter

(i) Lecture on "Building a Space Telescope" on 23rd April 2021

To commemorate INAE Foundation Day Celebrations, the INAE Mumbai Chapter organized a Lecture on "Building a Space Telescope" by Prof Varun Bhalerao, Department of Physics, IIT, Bombay on 23rd April 2021 over WebEx. The Lecture was coordinated by Prof. AK Suresh, FNAE, Co-Chair, INAE Mumbai Chapter and Professor of Chemical Engineering, IIT Bombay.

Prof Varun Bhalerao highlighted that Astrophysics deals with questions at the largest possible scales: starting from the birth of the universe, ultimately helping to understand our origins and our place in the cosmos. Astrophysics is uniquely differentiated from other experimental branches of science, as we have no control over the experiments: we

merely have to observe, analyse, and understand whatever the universe presents to us. Our main tool for unravelling the complex phenomena occurring billions of light years away are today's cutting-edge telescopes observing at all frequencies from radio waves to X-rays and Gamma rays.

The Earth's atmosphere is opaque to many bands of radiation – like ultraviolet and X-ray – which is a boon for life. But if we want to study such radiation from distant objects, we have to launch our telescopes to space. India has a strong space program, and a rich history of scientific space missions. Six years ago, India launched AstroSat: a home-grown observatory that has since provided phenomenal information on a wide variety of objects like black holes, pulsars, distant galaxies, young clusters of stars. India's space astrophysics ambitions continue with proposed missions like Daksha, that will deploy two space telescopes for detecting energetic explosions in space. Daksha telescopes are planned be an order of magnitude better at this task than any space telescope ever launched!

But space is a harsh, unforgiving environment – resulting in very stringent constraints when designing space telescopes. A space telescope undergoes high stresses starting right from launch – when intense vibrations can loosen or break any usual structures. The journey to protect the telescope begins a long time before launch: in the design process itself. Each component goes through many iterations of design, simulation, laboratory tests, and verification. A wide range of functional, thermal, vacuum, and vibration tests are used to identify and fix any potential problems. For example, something as simple as the base plate for mounting the telescope components has to be thought of like a giant gong which may start vibrating at its resonance frequency, damaging all equipment. We tend to think of space as a cold environment: but in Low Earth Orbit, the equilibrium temperature is often not far below some frigid places on Earth. The bigger problem lies with the temperature swing as the satellite keeps alternating between harsh sunlight and the Earth's shadow. For instance, in an early design iteration of Daksha, parts of the satellite were heating up to 80 ^{o}C when between the Sun and Earth, while components drastically cooled and attained freezing temperatures when in Earth's shadow. This dramatic temperature swing occurs once per 100-minute orbit, thousands of times a year – and would damage any structure. The designs were then revised again and again, bringing the swings and stresses to levels tolerable for the structure. And of course, another key challenge is the vacuum environment. Many materials can slowly release gas when placed in a hard vacuum. This gas forms a very low-pressure cloud around the components before eventually dissipating in space – a cloud behaving much like the gas in a tube-light or a "neon" light. If there are high voltage components present, they can cause a discharge glow: the gas becomes a conductor, causing short circuits and damaging or even permanently disabling components!

All these problems can be avoided by good design, but you can still get your share of scares. When the AstroSat team switched on the "Cadmium Zinc Telluride Imager" telescope for the first time after launch on 6th October 2015, we pointed it to the brightest X-ray source in the sky – the Crab pulsar. We were eagerly waiting for the data and when we processed it, we saw nothing but a blank sky. What was the source of the problem? The Crab pulsar was hidden behind Earth when we pointed the telescope there… a basic aspect we missed in the excitement! Within just a short while, we obtained data of the source emerging from behind Earth, obtaining exactly the expected image. Since then, there has been no looking back!

(ii) Webinar on "Production and Utilization of Green Hydrogen" on June 9, 2021

INAE Mumbai Chapter organized a Webinar on "Production and Utilization of Green Hydrogen" on June 9, 2021 which was attended by Fellows, Young Associates and other invitees. The Moderator was Dr R B Grover, FNAE, Co-Convenor, INAE Mumbai Chapter and Emeritus Professor, Homi Bhabha National Institute, Mumbai. The Lectures were delivered by the following six eminent Panelists:

1. Shri Kalyan Bhanja, Heavy Water Division, BARC on "Production by electrolysis"

2. Prof Prakash C Ghosh, Department of Energy Science and Engineering, IIT Bombay on "Fuel cell PEFC".

3. Dr Shriniwas Rao, Chemical Technology Division, BARC on "Production by I-S process".

4. Dr V Sudarsan, Chemistry Division, BARC on "Hydrogen Storage".

5. Prof Ganapati D Yadav, FNAE, Emeritus Professor of Eminence Institute of Chemical Technology, Mumbai on "Production by Cu-Cl process".

6. Dr Suman Roy Chowdhury, NMRL, DRDO on "Fuel cell PAFC"

In his introductory remarks, Dr. R B Grover stated that climate crisis calls for expeditious deployment of low-carbon energy sources. All countries around the globe are concentrating on decarbonizing the electricity sector. Replacing petrol- and diesel-driven light motor vehicles and two-wheelers have also been prioritized by governments around the globe. This is not enough. Fossil fuels are also used in making iron and steel, cement, different chemicals, shipping, aviation, and trucking.

To achieve the goal of limiting temperature-rise to 1.5 Celsius, energy professionals have to think in terms of decarbonizing the energy sector and not just the electricity sector. For decarbonizing the electricity sector, the IPCC process has recognized hydro, nuclear, solar, and wind as low-carbon technologies. Solar and wind are intermittent sources. As their penetration in the grid increases, the challenge of balancing the grid is becoming bigger and bigger.

Importance of hydrogen lies in the fact that it can be used to replace fossil fuels in industry and also be a part of the solution to balance the grid. Like electricity, hydrogen has to be produced, and considering the challenge posed by the climate crisis, it has to be produced by clean processes. Some sectors such as chemicals already use hydrogen. That is produced mostly from steam reforming of methane and that is not a clean process.

Let's now talk about the transport sector. For light vehicles, for city transport, it will be prudent to use electric vehicles as there are energy losses from the electrolyzer to the wheel. However, for long-haul heavy trucking, one may have to use hydrogen. In this case, there is an alternate view that a truck driver has to take rest every four hours. By providing charging infrastructure along highways, one can use electricity even for trucking.

In view of the fact that using hydrogen in internal combustion engines to power transport vehicles will cost about five times more primary energy, experiments using hydrogen via fuel cells are underway in many countries. Efficiency of fuel cells can be almost double that of internal combustion engines.

In India, MNRE is supporting a broad-based Research Development and Demonstration (R&D) programme on Hydrogen. Efforts by MNRE have resulted in development and demonstration of internal combustion engines, two wheelers, three wheelers, and mini buses that run on hydrogen fuel. Two hydrogen refuelling stations have been established (one each at Indian Oil R&D Centre, Faridabad and National Institute of Solar Energy, Gurugram). However, for shipping, hydrogen is perhaps the only solution.

Summarizing, Dr. Grover said,

- We have to decarbonize the energy sector and not just the electricity sector.
- The importance of hydrogen lies in the de-carbonization of the energy sector as it can de-carbonize industry, heavy transport, shipping, and aviation.
- To achieve this, we have to produce hydrogen in bulk.

He requested all the panelists to speak about technologies for the production of green hydrogen under development in their labs, cost of production, requirements of capital expenditure, use of intermittent sources of electricity, influence of intermittency on the cost of production, fuel cell development, hydrogen storage, and transport, and any other issue they think is relevant.

Mr. Kalyan Bhanja (Heavy Water Division, BARC) made a presentation of electrolytic production of hydrogen. Electro-splitting of water for hydrogen production has unique advantage as the electrolyser is compact and modular in construction with few process steps compared to other chemical routes. There are three electrolytic Hydrogen production processes, namely alkaline water electrolysis (AWE), ion exchange membrane based pure water electrolysis, and steam electrolysis. As of now, only BARC has got indigenous technology for hydrogen production through AWE upto 10 Nm3/h. The cell module has compact filter press type construction with nickel bipolar electrode plates separated by membrane, producing high purity hydrogen as well as oxygen, simultaneously. The unique porous nickel electrode gives very high current density and the membrane gives high purity gases. The cell performance matches with international established manufacturers in terms of energy efficiency. At present, R&D is going on for scale up and BARC was looking forward to participation of industry to accelerate this development.

BARC is also working on Proton Exchange Membrane (PEM) based pure water electrolyser development and has demonstrated laboratory scale system for its performance in electrolyser as well as fuel cell mode. Unique feature of the system is, development of Membrane Electrode Assembly (MEA) using indigenous SPEEK-PEG-SiO_2 membrane, instead of imported Nafion. BARC has also demonstrated steam electrolysis for hydrogen production using YSZ-LSM based system, which has been developed in-house. Special feature of BARC technology is that it is of tubular type, which is having advantage in multiplication or scale-up, compare to planner design.

Prof PC Ghosh (Department of Energy Science and Engineering, IIT, Bombay) presented a case for polymer electrolyte fuel cells (PEFCs), which are at the early stage of their commercialisation, and have the potential for different applications. However, PEFC technology faces several challenges and uncertainties during the pre-commercialisation phase. Platinum, used as the catalyst in PEFCs, is considered one of the critical obstacles towards commercialisation as it contributes significantly to the overall cost. Prof Ghosh made the case that around 90-95% of the Pt used in the PEFC is available at the end of its lifetime. Hence, a fuel cell-based transport system with platinum catalyst is something like "a locker on the wheel" since it can offer high salvage value leading to a profitable case. Therefore, the high investment in platinum could be beneficial instead of acting as the hurdle if the salvage value of platinum is considered. Hence, the high cost of platinum might promote the commercialisation of the fuel cells if an appropriate business model is in place. Therefore, the cost of platinum should not be considered as a hurdle towards commercialisation.

On the other hand, the sustainable supply of platinum to cater to fuel cell production only for the fuel cell-based electric vehicle is considered a long-term hurdle. The initial value for the reserves is based on a report in the South African Journal of Science by R. G. Cawthorn that estimates 48,000 Mg of platinum exists worldwide. According to the estimated the worldwide car production is reached 97 million per year. Considering a loading of ~20 gm per car (100 kW), an amount of 2,000 Mg of Pt is required per year to produce only PEFC based electric vehicles. Hence, there are no options left other than recycling the platinum for offering a sustainable solution. If platinum is recycled, only 200 Mg of platinum is required per year only for cars. Hence, platinum must be recycled to make the PEFC system sustainable.

Dr. V. Sudarsan, (Head, FMS, Chemistry Division, BARC) made a presentation on Metal hydrides as candidates for Hydrogen Storage Technology. He spoke about extensive work being carried out in BARC for developing efficient technologies for storing hydrogen. It is now well established that among the different storage options available, solid-state hydrogen storage along with the fuel cell technology is the best option for transport applications as it can fulfil the criteria such as safety, efficiency and cost. In this regard a variety of materials which include main group elements, transition metals/alloys, porous carbon, carbon nanotubes etc., were investigated in detail in the recent past. Based on these studies, two systems namely nano-engineered magnesium and transition metal based ternary alloy Ti2CrV are found to be promising for this application. Both the systems have advantages and disadvantages. Nano-engineered Mg based systems show high hydrogen storage capacity of around 7 wt.%, however, desorption of hydrogen starts around 160°C and above. In the case of Ti2CrV the storage capacity is around 4 wt.%, while hydrogen desorbs at around 70°C. Currently both systems are being investigated in parallel for evaluating the long-

time cyclic stabilities for large scale applications. Detailed cost calculations using the IAEA developed Hydrogen Economic Evaluation Program (HEEP) also confirms that solid-state hydrogen storage technology based on above type of materials/alloys will be cost effective compared to the conventional cylinder-based storage methods.

The presentation by **Dr Shriniwas Rao** (Chemical technology Division, BARC) covered the development works carried out in hydrogen production from various thermochemical cycles which are used in conjunction with a green heat source. Iodine-Sulphur thermochemical process which is expected to have higher efficiency, was dealt in detail by him. The challenges encountered in the developmental work, future plans and the international status was also discussed.

Prof GD Yadav (Emeritus professor of Eminence, ICT, Mumbai) delivered a talk on "Production of Green Hydrogen and The Net Zero Goal: Potential of ICT-OEC Process" which is summarized as follows. Green hydrogen can be used as a feedstock, a fuel, or an energy carrier and storage, and has numerous applications across different industries, and in transport, power, and building sectors. It is the key to decarbonize industrial processes reducing carbon emissions, which is both important and challenging to achieve. Adaption of Green Hydrogen Technologies, for instance, ICT-OEC Technology will add to the might of India's commitment to the Paris Agreement on Climate Change to make the Net (Carbon) Zero Emissions to contain temperature rise to less than 1.5^{0} C. Hydrogen economy can be elegantly intertwined to make many chemicals from waste carbon sources including biomass and C1 off-gases.

What we need in the future are integrated plants for hydrogen production from water splitting and its use in controlling environmental pollution and climate change, as well as production of many chemicals by the carbon dioxide refineries. We need a novel, realistic rethinking of the energy policy—from transitioning from coal to petroleum to gas and eventually to electrification of transport, to carbon pricing and a focus on new technologies.

There is a need to develop different hydrogen production technologies and to evaluate their impact on energy and environment to meet the net zero goal. Biomass should be used for production of valuable chemicals and materials, and NOT as a source of fuel. Govt of India should adopt hydrogen economy to meet the demands of the Paris Agreement ICT-OEC Hydrogen Technology, where the cost of production of hydrogen is less than a dollar per kg without valorization of oxygen, is one of the most viable technologies and should be part of Hydrogen Mission. This comparison was made on the basis of 19 other available technologies in the world.

Dr. Suman Roy Chowdhury (NMRL, DRDO) opined that considering the limitations of other sources to fill up the void that will be created due to withdrawal of the fossil fuels, it will be essentially the solar energy and its derivatives that need to be exploited to a much higher level in near future. However, since solar energy is diluted and intermittent (about 4-5 hours of good radiation per day), it calls for energy storage technologies, to the tune of ~4000 GWh, in a distributed manner to provide uninterrupted power when solar is not available. Technologies for the hydrogen grid components viz green hydrogen generation, transportation, exploitation and stabilization need to be seen in a holistic manner and suitable technology configurations need to be identified with performance markers, for e.g. hydrogen generation technologies like water electrolysis (at <1.5V), direct solar photolysis of water (efficiency >10%), H2-halogen electrolysis (at near thermodynamic potential) etc. needs to be evaluated for suitability. Similarly, H2 transportation technologies (like high pressure solid state compressors like electrochemical and hydride compressors), H2 energy exploitation (thru Pt free-low cost, high efficiency fuel cells - for e.g. hydrogen-halogen fuel cells and other flow battery technologies) need to be checked as a part of the total system and not in isolation. There is a dire need to have a comprehensive policy document on green hydrogen grid for managing fast growing solar energy in India. The document must bring out all possible technologies for the green hydrogen grid and compare the efficiency of the full power train vis-à-vis competitive technologies and identify the performance goals for the same, while evaluating the feasibility of implementation wrt cost, technology readiness, suitability, statutory regulations etc.

Dr Chowdhury opined that an accredited body like INAE may take the lead, and through a committee of experts publish a technology goal document to allow policy makers, researchers and industries to prioritize development and implementation of such a grid. NMRL with her rich experience of developing and industrializing fuel cell/ hydrogen energy based power solution for defence use may support such a cause by sharing the rich development experience related to technology evaluation, development and deployment through a multi-party system.

(iii) Webinar on "Future Mobility: E Mobility" on 9th August 2021

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

The following were the speakers and the topics they addressed:

1. Prof KV Krishna Rao, Department of Civil Engineering, IIT Bombay, on "Sustainability considerations in mobility options"

2. Dr Rutooj Deshpande, Battery Scientist and CEO, GoVidyouth mobility Pvt Ltd., on "Battery Technologies: Challenges and Opportunities"

3. Prof Sandeep Anand, Department of Electrical Engineering, IIT Bombay, on "EV Power train: R&D Challenges and solutions"

4. Dr Sajid Mubashir, Department of Science and Technology, GoI, on "Four power classes of EV infrastructure"

5. Sri Suman Basu, Head, Energy storage systems, Mahindra EV Technical Centre, on "e-Mobility: A perspective from Industry"

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

Sustainability considerations in mobility options (Prof KV Krishna Rao):

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

Battery technologies: Challenges and Opportunities (Dr Rutooj Deshpande):

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

EV Power Train: R&D Challenges & Solutions (Prof Sandeep Anand):

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

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

Four power classes of EV infrastructure in India (Dr Sajid Mubashir):

In his talk, Dr Mubashir spoke about the development of Indian standards for safety and testing of EV charging devices, AC &DC charging devices for light EV and DC fast charging devices for cars & buses (both CAN & PLC Communication Systems). He also talked about the standards under development, for destination charging of cars (both AC & DC), High Power Charging Systems for Buses: Automated Connection Systems and Dual Gun Charging Systems, and Battery Swap System for Light EV & eBus.

E-Mobility: A perspective from Industry (Mr Suman Basu):

Mr Basu spoke about the different aspects of Li-ion battery pack design, a key enabler of e-mobility, and also in general about the broader perceptions in industry on the possibilities on e-mobility. Electric vehicle revolution has finally reached the shores of India. Electric vehicle has been made possible due to the advent of high energy density, reversible, high efficiency electrical energy storage devices — in other words, Li-ion cells. Therefore, Li-ion battery pack design is the single most important aspect of the electric vehicle design. Battery pack design is an interdisciplinary subject involving packaging, structural, thermal, electrical and electrochemical aspects. Enough energy needs to be safely packaged and thermally managed within a given volume with weight constraint. Behaviour of the cell must be well understood and controlled to achieve best performance and/or life. A point to remember here

is that there is no "perfect cell". A cell will be chosen based on energy density, power density, life expectancy, safety and cost. It is highly usage specific and can often have multiple solutions.

The most crucial part of the battery pack design is the battery management algorithms including the cells state estimation. A robust and efficient battery management system can improve the performance and life expectancy of a battery pack significantly. There is a lot of scope for using advanced techniques like AI, cloud computing, prognostics to this end. For India, it can be an opportunity to differentiate itself from others and develop a niche product.

(iv) "Decarbonisation of Cement, Steel & Power sector" on 22nd October 2021

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

Decarbonisation of Cement, Steel & Power sector

Ulhas Parlikar, Presentation made on 22nd October 2021

Abstract

Release of a large quantity of CO_2 by the industry sectors into the environment is the reason for the ongoing climate change. The three industry sectors that contribute maximum to the CO_2 emissions are Power, Steel and Cement. These industries are preparing to control the emissions so as to ensure <1.5% Deg. C increase in the ambient temperature compared to the pre-industry period. Some of them are also trying to achieve net zero CO_2 status in a defined time line. The major levers available for them to achieve the same are following.

1. Improve the resource efficiency in their operations.
2. Reduce the use of fossil fuels and raw materials that contribute to CO_2 emissions.
3. Replace the fossil resources with renewable ones such as green Hydrogen
4. Replace the fossil fuel-based energy with renewable energy such as Solar, Wind, geothermal, tidal, etc.
5. Convert CO_2 into Algae and use it as fuel.
6. Conversion of CO_2 into value added chemicals.
7. Carbon Capture & Sequestration.
8. Utilize waste materials as resources in the manufacturing process. (Co-processing)

Co-processing is based on the principles of industrial ecology and stands for the usage/disposal of waste material in Resource Intensive Industries (RII). Co-processing option facilitates circular economy and offers a large opportunity for these industries to reduce their CO_2 emissions. Cement industry is a leader in the co-processing initiative and utilizes large quantities of wastes derived out of industrial, municipal and agricultural sectors as Alternative Fuels and Raw materials (AFRs) in cement manufacture. There are a few cement plants globally that are able to replace the fossil fuels to an extent of >90% and also a few who are able to replace raw materials up to >60%. The technology of co-processing in cement industry is a highly developed science and it is well recognized by most of the stakeholders. Based on large number of demonstration trials, it has been approved as an option for management of Hazardous and difficult to treat waste by the international

conventions such as Basel Convention and Stockholm convention. It has also been recognized as a preferred option for waste management in most of the developed countries and also some of the developing countries. To utilize wastes as resources they need to be processed through a technology called pre-processing and since these resources get involved into chemical reactions in cement manufacture, they need to be pass through a strict quality control assessment. Cement industry is able to demonstrate that it is feasible to reduce the GHG emissions by more than 70% by use of wastes in its manufacturing process.

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

(iv) Webinar on Why is "Urban Air Pollution" a Regional Misnomer: The India narrative by Prof. Chandra Venkataraman, FNAE, Interdisciplinary Programme in Climate Studies & Department of Chemical Engineering, IIT Bombay on February 19, 2022

Prof. AK Suresh, Department of Chemical Engineering, IIT Bombay, acted as Moderator for the session.

Brief Summary of the Talk

India currently experiences severely degraded air quality, while future economic development will further increase challenges for air quality management. The National Clean Air Programme (NCAP) proposed a laudable and ambitious goal of reducing ambient PM-2.5 concentrations (particulate mass in particles smaller than 2.5 μm aerodynamic diameter) by 20-30% by 2024, over 2017 levels. This target is set for over two hundred cities in non-attainment of the national ambient air quality standards (NAAQS). Strategies for effective mitigation of air pollution require strong scientific underpinning. With this general backdrop, Prof Chandra described the evidence built using multiple modelling methods, integrated with observations. The questions tackled included those on sources which most strongly influence air pollution, regional transport of emissions across parts of India, spatial distribution of population impacts and, importantly, how climate change might affect air pollution levels. An important development to address such questions is that of an emissions inventory, the Speciated Multi-pollutant Generator (SMoG-India). Prof Chandra also described optimized modelling platforms, like the WRF-Chem RCM and ECHAM6-HAM2 GCM for aerosol simulations to accurately capture mesoscale meteorology, dust transport and deposition, the aerosol lifecycle, photochemistry and secondary aerosol formation. A particular focus of the talk was the regional dominance of non-formal sources (including residential-biomass cooking, agricultural stubble burning and fired brick production), which are dispersed and discontinuous in nature. The influence of long-range transported pollutants, not just local sources, was demonstrated; this requires assessment and intervention measures on regional scales (state and district), rather than on urban scales, being undertaken in the NCAP. Prof Chandra discussed the recent research findings from her group, which indicate that radiative feedback to meteorology, which increases with climate change, could worsen air pollution levels. Thus, the disproportionate impacts of air pollution mortality and morbidity on non-urban citizens was highlighted. The talk concluded with suggestions on the priorities to address the complexity of an effective portfolio of mitigation solutions.

Brief biodata of Prof. Chandra Venkataraman

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

INAE Hyderabad Chapter

(i) Lecture on "Role of Artificial Intelligence in Missile Applications" on 9th Dec 2021

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

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

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

(ii) Lecture on "Material for Defence: Challenges and Opportunities" on 17th January 2022

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

Development of new Defence Materials usually face three specific challenges namely low volume, stringent qualifications and very long development time ranging from 5 to 20 years. The speaker discussed in length on above

challenges and presented 4 indigenous case studies of material developments (Naval Steel, Titanium, Nickel cobalt and DMR-1700). In order to expedite the development of new materials, he proposed innovative strategies such as Integrated computational material engineering, Material Genome Initiative and Material development Continuum.

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

INAE Kanpur Local Chapter

"100 seconds": a technical video competition

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

Under the flagship of INAE's commemoration of 75 years of independence via "Azadi ka Amrit Mahotsav", INAE Kanpur Chapter organized the competition "100 seconds".

Entries were invited in the following ten Engineering Domains:

1. Aerospace Engineering
2. Chemical Engineering
3. Civil Engineering
4. Computer and Information Technology
5. Electrical Engineering
6. Electronics & Communication Engineering
7. Energy Engineering
8. Mechanical Engineering
9. Mining, Metallurgical and Materials Engineering
10. Interdisciplinary and Special Engineering Fields

The portal opened in the middle of Sep. 2021, and the submission deadline was set in Oct. 22, 2021 (receiving ~ 25 entries), which was later extended to Nov. 19, 2021 (increasing the entries to 36 videos). The 100 seconds videos were received under the 8 engineering domains, but no entries were received in Civil Engineering and Energy Engineering during the competition. Each video entry was adjudged by at least two experts. In case of any disparity between the recommendations made by the two independent jurors, the ranking was finalized by the INAE Kanpur executive committee. INAE Kanpur chapter is very excited and hopeful that this competition will gain momentum, visibility, and popularity in the coming years. A sincere appreciation to all the participants for their contribution to this technical competition …after all… it was all said in 100 seconds!

List of Winners:

S. No.	Engineering Domain	Winners
1.	Aerospace Engineering	First Place: Srianish Vutukuri, IISc Bangalore
2.	Chemical Engineering	First Place: Asna Mariyam, MANIT Bhopal Second Place: Uma Dwivedi, IIT Delhi
3.	Civil Engineering:	NONE
4.	Computer and Information Technology	Consolation Certificate: Saikat Sarkar, AKCSIT, Uni. of Calcutta
5.	Electrical Engineering	First Place: Arnab Sarkar, IIT Kanpur Second Place: Shubhadeep Paladhi, IIT Kharagpur Third Place: Sathyamoorthy D., IIT Ropar
6.	Electronics & Communication Engineering	First Place: P. N. Karthik, IISc Bangalore Second Place: Tina B.S., IIST Trivandrum Third Place: Pramod Martha, IIST Trivandrum
7.	Energy Engineering	NONE
8.	Mechanical Engineering	Consolation Certificate: Indraneel C. Naik, CoE Pune
9.	Mining, Metallurgical and Materials Engineering	First Place: Chinmayee Nayak, IIT Kanpur
10.	Interdisciplinary and Special Engineering Fields	First Place: Divagar M, IIT Madras Second Place: Rituparna Saha, IIT Bombay Third Place: Nitish Kumar Gupta, IIT Kanpur

Prizes for Winners:

First Place: Recognition Certificate with cash prize of Rs. 5,000

Second Place: Recognition Certificate with cash prize of Rs. 3,000

Third Place: Recognition Certificate with cash prize of Rs. 2,000

Consolation Certificate: Recognition Certificate

INAE Delhi Local Chapter

(i) Webinar and Panel Discussion April 8, 2021 - Talk by Dr. Swarun Kumar on "Towards City-Scale Low-Power Wireless Internet"

A webinar and Panel Discussion were organized by IEEE ComSoc Bangalore & Delhi Chapters in association with ACM India Council and INAE Delhi Chapter on April 8, 2021 featuring a talk by Dr. Swarun Kumar Assistant Professor, Carnegie Mellon University on the topic "Towards City-Scale Low-Power Wireless Internet".

The abstract of the talk:

The number of gadgets in India has crossed then the number people. The challenge is designing the wireless network for city scale IoT, large number of devices cannot be charged every day, must talk to the base station even the UE is 10 miles away. Wi-Fi/Bluetooth does not give such high range. However, Lora can provide wide coverage range. Lora uses chirp spread spectrum technology where the frequency increases linearly with time.

The paper titled "Charm: exploiting geographical diversity through coherent combining in low-power wide-area networks", presented in IPSN'2018 proposed coherent combining of the signals at the cloud received from multiple gateways. This method is useful to recover the original signals at the cloud even when the signal is transmitted at a very low power and increases the battery lifetime. Because of the wireless modulation scheme of lora arbitrary data also has some pattern which can be recovered at cloud. Since the data is broken into multiple packets to transmit through multiple gateways, it results a huge bandwidth saving. The method is implemented in FPGA, Raspberry pi, SDR. To make the devices completely battery less, RFID tags are used which are powered by energy harvesters. However, the range is limited to 5-10m. To increase the range between RFID reader and RDID tags, a model named "PushID" is used where existing RFID readers collaborate with each other. It provides 8 times increment in range.

A Panel discussion on "Communication research and mindset" was also held and the Panellists were Dr. Swarun Kumar, Carnegie Mellon University; Dr. Sreeja Sukumaran, Christ University; Dr. Pinaki Bhaskar, Samsung and Dr. Abhinav Kumar, IIT-Hyderabad.

Brief Bio of the Speaker:

Dr Swarun Kumar is an assistant professor at Carnegie Mellon University (CMU) where he heads the laboratory for emerging wireless technologies (WiTech lab). He designs and builds novel systems to enable faster wireless networks and new services. Dr. Kumar is a recipient of the NSF CAREER award and Google Faculty Research Award. Dr. Kumar received the George Sprowls Award for best Ph.D thesis in Computer Science at MIT and the President of India gold medal at IIT Madras.

(ii) INAE Industry Lecture "Energy Efficient IoT Devices - the Quest for Longer Battery Life" on July 29, 2021

INAE Delhi Chapter organized an INAE Industry Lecture (webinar) on July 29, 2021from 2-4PM. The lecture was scheduled through MS-Teams app. The title of the Lecture was "Energy Efficient IoT Devices - the Quest for Longer Battery Life" and the Speaker was Mr N Venkatesh, Sr. Director, Silicon Labs, Hyderabad.

Abstract of the Lecture: Many or most connected devices - like smart watches, smart locks, location trackers, medical monitors - require long battery life. Since battery technology is not growing at the same pace as the volume of data transferred between devices, innovative methods and techniques to improve energy efficiency have become critical. The question of energy consumed is important in all activities of IoT devices including sense/control, compute, intelligence and communication. This talk covers the current practices in fundamental HW/SW architectural considerations, and algorithmic methods for achieving a very low power wireless end node ASIC design without sacrificing performance. Areas of focus such as HW/SW partition, algorithms, energy efficient wireless receiver algorithms, sleep states, and dynamic performance scaling will be drilled down to explain practical challenges faced in design of wireless SoCs. The talk includes how battery life enhancement is a joint endeavour involving semiconductor device construction and control, the simultaneous use of multiple architecture level techniques, and a seamless approach to wireless design involving algorithms, hardware realizations and software control.

Bio of Speaker:

Mr N. Venkatesh is Senior Director, Engineering at Silicon Labs through its March 2020 acquisition of Redpine Signals of which he was one of the founders in 2002. Mr. Venkatesh has over 35 years of engineering and management experience in wireless system design, IoT solutions, semiconductor design, and avionics. His current areas of interest are on building semiconductor and system solutions in the field of the Internet of Things. Prior to Redpine Signals, he was General Manager at California based Paxonet Communications

developing semiconductor devices for optical and telecom networks, and prior to that at HAL developing airborne communication systems. He is an active IEEE volunteer and was the Chair of IEEE Hyderabad Section in 2019. He is a Board Member of TiE Hyderabad and helps foster entrepreneurship.

Mr. Venkatesh holds a Masters Degree in Electrical Engineering from the Indian Institute of Technology, Madras, India. He holds 22 US patents, has contributed to IEEE standards development and has written numerous articles in technical journals. He is a Fellow of the Indian National

Academy of Engineering and a recipient of the VASVIK Award for Industrial Research in 2011.

(iii) Webinar on "Benefits and challenges in the next decade of semiconductor innovation" on August 19, 2021

INAE Delhi Chapter organized a seminar on August 19, 2021, starting at 10:00 AM. The webinar was held over MS Teams. The title of the lecture was "Benefits and challenges in the next decade of semiconductor innovation" and the speaker was Dr. Randhir Thakur, Intel.

Abstract:

In this talk, Dr. Thakur shared a synoptic view of past progress made by the semiconductor industry and of the continuing, insatiable future demand for innovation in semiconductor technology, so we can make sense of the growing volume of data generated in the world and improve the lives of every person on earth. The talk also covered Intel's IDM 2.0 strategy and conclude with opportunities for collaborations with academia and with the India semiconductor ecosystem.

Speaker bio:

Dr. Randhir Thakur is Senior Vice President and the President of Intel Foundry Services. Dr. Thakur joined Intel in 2017, bringing 30 years of experience as a hands-on innovator and business leader with expertise in global manufacturing, research and development, and profitable P&L management. Thakur joined Intel as corporate vice president of Global Supply Management, expanding his role to chief supply chain officer in 2020. His deep expertise in global semiconductor manufacturing, ecosystem leadership, process technology equipment and customer orientation are critical to the success of Intel Foundry Services. Thakur earned a Bachelor's degree in electronics and telecommunications engineering from the National Institute of Technology, Kurukshetra, in India; a Master's degree in Electrical Engineering from the University of Saskatchewan in Canada; and a Ph.D. in Electrical Engineering from the University of Oklahoma. He was named a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) in 2013 and has made seminal contributions to the semiconductor industry. He holds more than 300 patents.

(iv) Webinar on "Livin' in a Material World: Materials Driving the Data Storage Revolution" on October 28, 2021

INAE Delhi Local Chapter in collaboration with the Electrical Engineering Department & School of Interdisciplinary Research, IIT Delhi organized a Webinar on "Livin' in a Material World: Materials Driving the Data Storage Revolution" on October 28, 2021 wherein a Talk was delivered by Dr. Siva Sivaram, President, Technology and Strategy, Western Digital, USA. About 90 participants attended the Webinar. The Abstract of the Talk and brief bio of speaker are given below.

Abstract:

We are in midst of a data revolution, with the amount of data created annually increasing rapidly. Global data consumption has been estimated to hit 175 Zettabytes by 2025. Rotating media HDD and solid-state Flash storage

continue to play pivotal roles in the nonvolatile data storage ecosystem. Against the backdrop of this unrelenting demand, the industry must continue to deliver innovative, scalable, cost efficient, diverse technologies, with fundamental materials science as a key enabler. In this talk Dr. Sivaram provided an overview of industry dynamics and show how the physical sciences have been at the heart of enabling this continued technology revolution.

Brief Bio of the Speaker:

Dr. Siva Sivaram is the President, Technology and Strategy for Western Digital, USA. He previously served as executive vice president, Silicon Technology and Manufacturing, where he led worldwide development of silicon technologies and their high volume manufacturing across sites around the globe. Dr. Sivaram has over 30 years of experience in semiconductors, 3D memory architectures, process technology, equipment and materials. He has held executive positions at Intel and Matrix Semiconductor, and at SanDisk after its acquisition of Matrix. Additionally, he was the Founder and CEO of Twin Creeks Technologies, a solar panel and equipment company. He is widely published, including a text book on Chemical Vapor Deposition and holds several patents in semiconductor and solar technologies. He serves on the board of the Global Semiconductor Association. Dr. Sivaram earned his doctorate and master's degrees in materials science from the Rensselaer Polytechnic Institute where he has been elected to its Board of Trustees. He is a Distinguished Alumnus of the National Institute of Technology Trichy, India, where he earned his bachelor's degree in mechanical engineering.

INAE Bhubaneswar Local Chapter

(i) Webinar on "Data Analytics, Machine Learning and Deep Learning" on April 27, 2021

INAE Bhubaneswar Chapter organized a Webinar on Data Analytics, Machine Learning and Deep Learning jointly with Computer Science and Engineering Department of Siksha 'O' Anusandhan (Deemed to be University) on April 27, 2021. Professor Ganapati Panda, a member of Bhubaneswar Chapter gave an overview of the subject in simple and lucid manner for the benefits of the students and faculty. A large number of students and faculty from SOA and other institutes in India and from a few Institutes from abroad attended this seminar. In Addition to Professor Panda, three other Fellows of the Academy, Professor P.K. Mishra, Dr. Debashis Deb and Prof. Damodar Acharya attended this webinar conducted in virtual mode. INAE Bhubaneswar Chapter thanked CSE Department of SOA University and particularly its HOD, Prof. Debahuti Mishra for help in organizing the Webinar. The Chapter promised to have more such seminars/Webinar to be given by INAE Fellows in future.

(ii) Distinguished Lecture Series:

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

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

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

fibre amplifier, FBG based sensor for structural health monitoring, Societal impact of CSIR developed ceramic hip prosthesis, Translational Research is important.

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

(b) The 2nd Lecture of the Distinguished Lecture Series was organized by INAE Bhubaneswar Chapter jointly organized with SOA University and IMMT Bhubaneswar on 7th January 2022 by Prof. Suman Chakraborty, Institute Chair Professor & Sir J C Bose National Fellow, Professor in the Mechanical Engineering Dept. of the Indian Institute of Technology Kharagpur on "Democratized Diagnostic Technologies towards Affordable Healthcare for the Underserved". 204 attendees participated in the Lecture.

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

Link to the Video: https://youtu.be/hW_VLs45JkM
People Participated: 200

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

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

Link to the Video: https://youtu.be/PQlYu6H2md8
People Participated: 150

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

Key Points:

- Policy framework to be created to promote market for advance materials
- India should see itself as a manufacturing hub for the entire world market
- Encourage through funding collaborative technology development between industry, government, academia and MSME
- Ensure academic research supports technology development in new materials
- Design thinking for sustainable use of materials
- Need for independence in strategic materials
- Driven by aerospace, wind energy, sports, automotive
- As volume grows, cost will decrease
- Future of Graphene
- Titanium- an opportunity waiting

Link to the Video: https://youtu.be/bMXNaPXERjU
People Participated: 100

(e) The 5th Lecture of the Distinguished Lecture Series was Organized by INAE Bhubaneswar Chapter, SOA University and IMMT Bhubaneswar on "Achieving Sustainability and Net Zero Mandate through Adoption of Hydrogen Economy, CO_2 Refineries & Biomass Conversion" by Prof Ganapati D. Yadav on 8th March 2022.

Key Points:

- Energy, Environment and Climate Change. Energy and environment are intimately connected. More energy, more environmental damage, The climate change is due to the overuse of fossil fuels leading to emissions of CO_2 which is currently at 419.2 ppm. The energy needs of the world are increasing day by day and use of carbon-based fuels will continue to rise. Jan. 2020; 410 ppm, Jan. 2021: 412 ppm (Slowdown in economy) In order to meet the requirements of international treaties, the use of renewable resource is advanced.
- Carbon based fuel and H2 as Saviour

  Whether the carbon is coming from, fossil fuels or biofuels there is a need to cover CO_2 into fuels, chemicals and materials. Hydrogen is the cleanest fuel which can be produced from hydrocarbons or from water and can be used to convert CO_2 into useful products. And treatment of (waste) biomass into hydrocarbons with the help of novel catalysts. Hydrocarbons can also be reformed into hydrogen, but CO_2 needs to be utilized.

  Hydrogen will be the SAVIOUR for the planet EARTH.

Link to the Video: https://youtu.be/ve-l_rOdTfk
People Participated: 130

International Affairs

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

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

CAETS Energy Group

CAETS Energy Group held discussions for preparing an International Study to be released in time for the next convention in September 2022. Mr. Pradeep Chaturvedi was nominated to the Energy Committee meetings. Dr. B. Bandyopadhyay also participated in the meeting. INAE representatives supported the preparation of the Scoping Paper of the Study and subsequently agreed to contribute to the Building Sector focusing on cooling practices. As a starting point, a presentation was requested by CAETS Energy Committee and delivered jointly by Dr. Bandyopadhyay and Mr. Chaturvedi on the topic "De-Carbonizing the Building Sector: Focus on Sustainable Cooling Strategies". INAE also supported in preparing the Energy Survey Format. Mr. Chaturvedi was selected to Co-Chair the building sector group. All contributions in preparing the scoping study, developing format for survey and the presentation on sustainable cooling strategies were highly appreciated by different member academies in the group. Subsequently, in meetings of Co-Chairmen discussion on Introduction, Conclusion and the First Introductory Chapter were also carried out. INAE helped group to develop these formats. The study is in the advance stage and various chapters are being written to be completed by early July.

As requested by the CAETS Energy Committee, Energy Group also arranged presentation by Mr. M. S. Unnikrishnan, IIT Bombay, on the topic Heat Pumps (on September 13, 2021); and by Prof. Ambuj Sagar, IIT Delhi on Regulation and Policy for Energy Efficiency, on September 14, 2021. Both the presentations were very well received and will be included in the proposed study.

CAETS – Sustainable Development Goals (SDGs) Working Group

The Members of the Energy Group discussed the requirements of SDGs Working Group and especially the statement proposed to be published in the week of 15 November 2021, immediately after COP-26. INAE nominated Mr. Pradeep Chaturvedi as representative from INAE in the Working Group. This working group was chaired by Royal Academy of Engineering, UK. CAETS – SDGs Working Group conducted discussions to understand how different Academies engaged with respective governments on sustainability policies and issues. The effort was also to understand good practices and develop understanding on challenges to build capacities in this area. Select academies were asked to make presentation on involvement of respective academies directly or through the government in attaining SDG Goals. INAE was also requested to make a presentation. Mr. Pradeep Chaturvedi prepared a comprehensive presentation

on INAE involvement in SDGs over the number of years through its expert groups, conclaves, and interaction with governments and various Studies and Reports. The presentation was highly appreciated and INAE's efforts in this direction were lauded. The SDGs Working Group considered specific purpose for its work: "To build capacity of CAETS member academies to take a greater leadership role in sustainability policy, by exchanging knowledge and best practices on how national engineering profession are influencing, driving and providing leadership for progress towards sustainability targets".

There was a strong feeling that promoting an engineering systems approach, as a way of achieving ambitious sustainability targets, is a natural space for engineering to operate in, and meets a key government need. It was observed that the working group members had interest in sharing knowledge on how to help government to take an engineering systems approach to achieving national targets. The group also recognized that this is especially crucial in this year (2021) with governments due to renew their Nationally Determined Contributions (NDCs) at the UN Conference of Parties (COP-26) Meeting in November 2021.

A number of working group meetings were held during the period to further explore specific approaches and guiding principles for academies. The working group therefore decided to also reflect its view point in the form of a Statement on the Outcome of COP-26 to be issued in the week of November 15, 2021 after COP-26 outcome. INAE was involved in drafting of the statement and finalizing the Statement to highlight the role of engineers and engineering academies to promote follow-up action where engineering supports attaining SDG targets. Extensive discussions were held with the Energy Group for effective participation in CAETS meetings. CAETS conveyed its appreciation of INAE's effort in drafting an effective and appropriate Statement.

Proposed Activities

INAE Energy Working Group also discussed the proceedings of the CAETS Energy Group and CAETS SDGs Working Group for the follow-up action. The energy group also realized that it can very effectively handle other related issues like SDGs, Climate Change and De-Carbonization of Economy. Earlier Energy Group Reports in 2017 and 2019 had focused on promoting renewable energy and use of clean energy sources for urban development. It has also worked on de-carbonizing the economy: a concept that was discussed at various times. The work done by the energy group formed the basis of the Study on De-Carbonization being conducted by CAETS Energy Group. The effort is to identify what other areas be considered for energy related activities that have direct impact on climate change and SDGs.

It is proposed that the programs considered by the Energy Group under the following two topics may be taken up for action:

a. Engineering for accelerated growth of carbon neutral renewable energy applications in India.

b. Development of breakthrough technologies for energy sector (for India and abroad) and strategy for cost effective utilization of fully developed technologies and emerging technologies.

In this regard, a beginning has been made at the INAE Engineers Conclave 2021; and it is proposed to have networking and brain-storming sessions among Fellows of INAE and other representatives of other professions, who must work alongside in a multi-disciplinary approach to attain Net-Zero by 2070.

The Fellowship

The selection process for election to the Fellowship was reviewed a few years back and modified wherein two stage selection process had been introduced. The comments from the Fellowship on the nominations received are also obtained prior to the first meeting of the Sectional Committees. In the first stage, the nominations are initially shortlisted to seek peer review reports from the recommended Fellows/domain experts. In the second stage, the peer review reports received are considered by the Sectional Committees to recommend nominations for election to the Fellowship for approval of the Governing Council. The following were elected as Fellows of the Academy w.e.f. November 1, 2021.

Newly elected Fellows

Engineering Section-I (Civil Engineering)

1 **Prof Vasant A Matsagar**, Dogra Chair Professor, Department of Civil Engineering, Indian Institute of Technology Delhi.

2 **Prof KVL Subramaniam**, Professor, Department of Civil Engineering, Indian Institute of Technology Hyderabad

Engineering Section-II (Computer Engineering &Information Technology)

1 **Prof Susmita Sur Kolay**, Professor, Indian Statistical Institute, Kolkata

2 **Prof Debdeep Mukhopadhyay**, Professor, Indian Institute of Technology Kharagpur

3 **Dr Ramachandran Ramjee**, Senior Principal Researcher and Director Intern program, Microsoft Research India

4 **Dr Gautam Shroff**, VP, Chief Scientist & Head, TCS Research, Gurgaon

5 **Dr Lipika Dey**, Principal Consultant, Tata Consultancy Services, Noida

Engineering Section-III (Mechanical Engineering)

1 **Prof Atul Sharma**, Professor, Department of Mechanical Engineering, Indian Institute of Technology Bombay

2 **Dr BK Sreedhar**, Scientific Officer H, IGCAR, Kalpakkam

3 **Dr Sathya Prasad Mangalaramanan**, Vice President, Product Development, Ashok Leyland Limited, Chennai

Engineering Section-IV (Chemical Engineering)

1 **Prof V. Shankar**, Professor, Department of Chemical Engineering, Indian Institute of Technology Kanpur

2 **Prof Ravindra D Gudi**, Professor & Head, Chemical Engineering Department, IIT Bombay

3 **Dr Amol Arvindrao Kulkarni**, Senior Principal Scientist, Chemical Engineering and Process Development Dept. (CEPD), CSIR-National Chemical Laboratory, Pune

4 **Ms Vartika Shukla**, Chairperson & Managing Director (CMD), Engineers India Limited, New Delhi

Engineering Section-V (Electrical Engineering)

1 **Prof Saikat Chakrabarti**, Professor, Department of Electrical Engineering Indian Institute of Technology Kanpur

2 **Dr Rahul Tongia**, Fellow, Brookings India, New Delhi.

Engineering Section-VI (Electronics & Communication Engineering)

1 **Prof Yogesh Singh Chauhan,** Professor, Department of Electrical Engineering, Indian Institute of Technology Kanpur.

2 **Prof Saurabh Lodha**, Dept of Electrical Engineering, IIT Bombay

3 **Mr Raghavan Muralidharan**, Chief Technology Officer, Tata Advanced Systems Limited, Mumbai

Engineering Section-VII (Aerospace Engineering)

1 **Prof Mira Mitra, Professor**, Department of Aerospace Engineering, IIT Kharagpur.

2 **Dr Ramesh Sundaram**, Chief Scientist; Head Advanced Composites Div (ACD) & Head Centre for Societal Missions and Special technologies (CSMST), CSIR-National Aerospace Laboratories, Bangalore

3 **Dr Sunder Ramasubbu**, Research Director, ITW-India Pvt Ltd

Engineering Section-VIII (Mining, Metallurgical and Materials Engineering)

1 **Prof Kantesh Balani**, Head, Advanced Centre for Materials Science, Indian Institute of Technology Kanpur

2 **Prof Jyotsna Dutta Majumdar**, Professor, Metallurgical and Materials Engineering, IIT Kharagpur and Chairperson, Central Research Facility, IIT Kharagpur

3 **Prof M. Kamaraj**, Professor, Dept of Metallurgical and Materials Engineering, IIT Madras

4 **Dr S.V. S. Narayana Murty**, Scientist G and Head, Materials Characterization Division, Vikram Sarabhai Space Centre, Thiruvanthapuram

5 **Dr Satyam Suraj Sahay**, John Deere Fellow, John Deere Technology Centre India, Pune

Engineering Section-IX (Energy Engineering)

1 **Dr BK Nashine**, Outstanding Scientist and Associate Director, Indira Gandhi Centre for Atomic Research, Kalpakkam

2 **Mr A K Balasubrahmanian**, Director (Technical), Retired, Nuclear Power Corporation of India Limited, Anushakti Nagar

Engineering Section-X (Interdisciplinary and Special Engineering Fields and Leadership in Academia, R&D and Industry)

1 **Prof Giridhar Udapi Rao Kulkarni**, President, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru

2 **Prof Suparna Mukherji**, Professor and Head, Environmental Science & Engineering Department, Indian Institute of Technology Bombay

3 **Prof Rohit Srivastava**, Professor and Head of Department of BSBE, IIT Bombay

4 **Prof Sandeep Verma**, Secretary, Science and Engineering Research Board (SERB), New Delhi

5 **Dr Ajit Kumar Mohanty**, Director, Bhabha Atomic Research Centre, Mumbai

Newly elected Foreign Fellows

1 **Prof Mike (Michael) Jon Schlaich**, Professor, Chair of Conceptual and Structural Design at the Technische Universität Berlin, Germany; Managing Director of schlaich bergermann partner, sbp

2 **Prof Arup K Chakraborty**, Robert T. Haslam Professor of Chemical Engineering, Professor of Physics, Professor of Chemistry, Massachusetts Institute of Technology.

3 **Prof Ned Mohan**, Regents Professor of the University of Minnesota / University of Minnesota at Minneapolis USA.

4 **Prof Palghat P Vaidyanathan**, Professor of Electrical Engineering, California Institute of Technology, Pasadena, CA, USA.

5 **Prof Jürgen Eckert**, Director, Erich Schmid Institute of Materials Science of the Austrian Academy of Sciences and Full Professor (Chair "Materials Physics"), Montanuniversität Leoben, Dept. of Materials Science, Leoben, Austria.

Fellows elected under Rule 37(g)

With a view to enhance the visibility of INAE in Industry domain and also to increase industry representation in the Fellowship, upto five exceptional eminent persons from the Industry category are being elected as Fellows/ Foreign F under the Rule 37(g) in a year since 2016.

This year, five eminent engineering luminaries elected as Fellows/Foreign Fellows under Rule37(g) were.

1 **Mr Vikram S Kirloskar**, Chairman and Managing Director of Kirloskar Systems Ltd. and Vice Chairman of Toyota Kirloskar Motor.

2 **Prof David Jeffery Wineland**, 2012 Nobel Prize in Physics, Philip Knight Distinguished Research Chair, Department of Physics, University of Oregon, USA.

3 **Prof Andrew Zisserman**, FRS, Professor of Computer Vision Engineering at Oxford University.

4 **Mr Sundar Pichai**, CEO of Google and Alphabet, USA.

5 **Dr Ajay Kumar**, Secretary, Department of Defence, Govt of India

Honours and Awards

The details of awards received by INAE Fellows during the year are given below.

Padma Awards 2022

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

Padma Bhushan:

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

Padma Shri:

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

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

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

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

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

The Video Interview can be viewed at the link https://youtu.be/8VuCIneyQiA

1	Dr Sanak Mishra, FNAE, former President, INAE; Member of the Governing Board of the Steel Research & Technology Mission of India; formerly Managing Director, Rourkela Steel Plant and Director, Steel Authority of India Ltd. (SAIL); Vice-President, ArcelorMittal and CEO India Projects; Secretary General, Indian Steel Association; President, Indian Institute of Metals had been recently interviewed by the Department of Materials Science & Engineering (MatSE) at the University of Illinois at Urbana-Champaign (UIUC) who posted on its website a Legendary Alumni Q&A interview with him which can be viewed at the link given below https://matse.illinois.edu/news/legendary-alumni-q-and-a-with-sanak-mishra
2	Dr. Tessy Thomas, FNAE, Distinguished Scientist & Director-General, Aeronautical System, Defence Research and Development Organisation (DRDO), Bangalore has been listed as one of the top 35 Most Influential Women Engineers of the world.
3	Prof Sanjit K. Mitra, FNAE, Professor Emeritus of Electrical & Computer Engineering, University of California, Santa Barbara, USA has been elected as a Corresponding Member of the Academia Nacional de Engenharia (Brazilian National Academy of Engineering).
4	Prof. K. Bhanu Sankara Rao, FNAE, Pratt & Whitney Chair Professor, at the University of Hyderabad (UoH) received Dr. N. Kondal Rao Memorial Award on July 15th, 2021 from Indian Society for Non-Destructive Testing (ISNT). He was felicitated by Dr. Dasharath Ram, Director Defence Research and Development Laboratory (DRDL), Defence Research and Development Organisation (DRDO); Dr. S.K. Jha, Chairman and Managing Director, MIDHANI and Dr. Jaitheerth Joshi, Project Director, DRDL and Chairman ISNT Hyderabad Chapter, at MIDHANI Auditorium in Hyderabad. On this occasion, Prof K. Bhanu Sankara Rao delivered an illuminating lecture on the "Indigenous Development of Ferritic-Martensitic Steels and Fabrication Technologies for Fusion Reactor (ITER)" which was live telecast and 400 people listened on-line.
5	Professor Chennupati Jagadish, FNAE, Editor-in-Chief, Applied Physics Reviews; Distinguished Professor, Department of Electronic Materials Engineering, Research School of Physics, The Australian National University, Canberra, Australia was elected as the next President of Australia's premier science organisation, the Australian Academy of Science. He is the first Australian of Indian heritage to take on the role. Further details are given in link below. https://www.canberratimes.com.au/story/7523642/nanotechnology-pioneer-to-take-on-australian-academy-of-science-presidency/?src=rss
6	Prof. Prem Krishna, FNAE, Formerly Professor & Head of Civil Engineering Department, IIT Roorkee; Founder President of Indian Society of Wind Engineering (ISWE) and former President IAWE has been conferred the International Association for Wind Engineering (IAWE) Presidential Award for career long contributions to wind engineering with particular reference to low rise structures, code development and leadership to the ISWE and IAWE, during an award ceremony held on October 28, 2021 presided by Prof Shuyang Cao, Secretary General, IAWE.
7	Prof S. C. Dutta Roy, FNAE, formerly Professor of Electrical Engineering, IIT Delhi received the 2021 Signal Processing Society Award in recognition of his half a century of teaching various facets of Signal Processing, which have changed the lives and careers of millions of students across the globe, through his classes and online lectures".
8	Prof. Sankar K. Pal, FNAE, Former Director and Distinguished Scientist, Indian Statistical Institute, Kolkata; formerly INSA Distinguished Professor; JC Bose National Fellow and formerly DAE Raja Ramanna Fellow and formerly INAE Chair Professor has been selected as a AICTE nominated AICTE Distinguished Chair Professor. He has also been elected a Fellow, Asia-Pacific Artificial Intelligence Association (AAIA).

9	Prof Sanjit K. Mitra, FNAE, Professor Emeritus of Electrical & Computer Engineering, University of California, Santa Barbara, USA has been elected as a corresponding member of the Academia Nacional de Engenharia (Brazilian Academy of Engineering).
10	Prof. Rajpal S. Sirohi, FNAE, Padma Shri, Former Director, IIT Delhi and Former VC Barkatullah University) received two awards in the year 2021 viz. IITD Alumni-Faculty Award 2021-2022 and Maria J. Yzuel Educator Award 2022 from SPIE - The International Society for Optics and Photonics. The SPIE Maria J. Yzuel Educator Award is presented annually in recognition of outstanding contributions to optics education by an SPIE instructor or an educator in the field. The SPIE Awards Committee recommended Prof Rajpal S Sirohi for the award in recognition his many years of service in the field of optics through leadership, capacity building and outreach.
11	The following INAE Fellows were elected as International Members of the NAE, USA in the year 2022.
	1. Prof G Bhuvaneswari, FNAE, Professor, Mahindra University École Centrale School of Engineering, Hyderabad and formerly Professor, Department of Electrical and Electronics Engineering, Indian Institute of Technology, New Delhi elected for contributions to advancement of power converters to improve power quality, and leadership in using advanced technologies for education. 2. Mr N Chandrasekaran, FNAE, Chairman, Tata Sons Private Limited, Mumbai elected for changing the nature and advancing the capabilities of the software industry in India. 3. Dr RD Kulkarni, FNAE founder, Elkay Chemicals Private Limited, Pune elected for innovation-centric business and technology development and leadership across disciplines. 4. Dr BN Suresh, FNAE, Chancellor, Indian Institute of Space Science & Technology (IIST) & honorary distinguished professor, Indian Space Research Organization, Bengaluru elected for contributions to advances in technologies for space exploration and for leadership to promote peaceful uses of outer space. 5. Prof GD Yadav, FNAE, emeritus professor of eminence, Chemical Engineering, Institute of Chemical Technology, Mumbai elected for research, innovation, and education in green chemistry, catalysis, nanotechnology, and chemical engineering leading to clean and green technologies.
12	Prof GD Yadav, FNAE, emeritus professor of eminence, Chemical Engineering, Institute of Chemical Technology, Mumbai was selected as a National Science Chair, a scheme of Science and Engineering Research Board (SERB), DST New Delhi.
13	Mr VN Heggade, FNAE, Chief Executive Officer (CEO), STUP Consultants Pvt. Ltd, Mumbai received the "OP Jain Memorial Structural Design Award – 2021 instituted by IIT Roorkee.
14	Prof Sudhir K Jain, FNAE, Vice – Chancellor, Banaras Hindu University, Varanasi and formerly Director and Professor of Civil Engineering, IIT Gandhinagar was conferred the Distinguished Alumni Award 2022 by California Institute of Technology, USA.
15	Prof Ranjan K. Mallik, FNAE, Institute Chair Professor and J. C. Bose Fellow Department of Electrical Engineering Indian Institute of Technology Delhi has been selected by the Jury for award of the 2021 IEI-IEEE Award for Engineering Excellence for significant contributions applying advanced design and analysis of wireless communication and for enhancing the capabilities of mobile communication systems.
16	Dr Archana Sharma, FNAE Director, BTDG, BARC, Mumbai has been selected in top 75 women professionals by PSA, GoI and British High Commission on March 3,2022

News of Fellows

1	Dr K Kasturirangan, FNAE, Chairman, National Education Policy (NEP) – 2020 and Chairman, Karnataka Knowledge Commission; Distinguished Professor Emeritus, National Institute of Advanced Studies (NIAS) and Formerly Chairman, Space Commission and Secretary, Department of Space, Bangalore; Formerly Director, National Institute of Advanced Studies, Bangalore; Formerly Member (Science), Planning Commission, New Delhi and Former Chancellor, JNU, delivered the University Distinguished Lecture on Saturday, 24th July 2021. The title of the talk was "Creating a Vibrant Knowledge Society - An Indian Strategy for 21st Century". Dr. Kasturirangan also delivered the 15th National Institute of Education Planning and Administration (NIEPA) Foundation Day Lecture on "Liberal Education: A 21st Century Imperative" on August 11, 2021.
2	Dr Sanak Mishra, FNAE, Member of the Governing Board of the Steel Research & Technology Mission of India and Formerly Managing Director, Rourkela Steel Plant and Director, Steel Authority of India Ltd. (SAIL); Vice-President, ArcelorMittal and CEO India Projects; Secretary General, Indian Steel Association; President, Indian Institute of Metals and Immediate Past-President, INAE recently co-edited a Special Volume on "Design & Manufacturing" published by Springer-Nature as the May 2021 issue of the Transactions of the Indian Institute of Metals. The speciality of this issue, with twenty-one invited papers reviewed and selected on merit, is that it focusses primarily on engineering and innovation. Several of the authors are INAE Fellows, and several of the reviewers are INAE Fellows as well. The co-editor was Prof. Jyoti Mazumder, Fellow INAE, who unfortunately passed away in April after a protracted health condition beginning November 2020.
3	Dr RK Bhandari, FNAE, Formerly Director, Central Building Research Institute, Roorkee & Programme Director, UN-HABITAT, Nairobi; Formerly Chairman, Centre for Disaster Mitigation and Management, VIT, Vellore has published a Guest Editorial on "National strategy for landslide risk management" in Current Science, Volume 120, No 7, 10th April 2021.
4	Prof SN Mukhopadhyay, FNAE, Adjunct Professor, Department of Biological Sciences, BITS, Pilani and Former Professor, DBEB, IIT Delhi; Former Professor & Head, BERC, IIT Delhi; Former Professor SOBT, GBU, Greater Noida, was been invited on April16, 2021 by Email from Rifacimento International Publisher in Delhi to be in their list of Rising Personality of the Year 2020 as Biographical Note in Asian-American Who's Who Publication.
	Prof SN Mukhopadhyay, FNAE, Adjunct Professor, Department of Biological Sciences, BITS, Pilani and Former Professor, DBEB, IIT Delhi; Former Professor & Head, BERC, IIT Delhi; Former Professor SOBT, GBU, Greater Noida, joined as an invited guest participant in Icon SWM-CE-2021 Workshop Technical Session I at Mechanical Engineering Department, Jadavpur University, Kolkata on 24th June 2021.
	Prof. S.N Mukhopadhyay has also been invited by Vidya Kutir Publications to contribute an article in its forthcoming book 'Advances of Atmospheric Research'. His submitted abstract on "Discovered God Particles In Advances of Atmospheric Research" has been accepted by the publisher.
5	Dr NK Tyagi, FNAE, Formerly director, ICAE-CSSRI, Karnal has authored a book "Tryst with Destiny- An Autobiography" published by Index International on his life-time experiences.
6	Mr AK Anand, FNAE, Director Technical, Microtrol Sterilisation Services Pvt Ltd, Mumbai and Formerly Director (Reactor Projects Group), BARC, Mumbai has contributed a chapter on 'Marine propulsion' for the Encyclopedia of Nuclear Energy to be published by Elsevier publications co-authored by Dr. J. Stephen Herring Director Center for Space Nuclear Research, Idaho. The chapter can be accessed by clicking on the link given below.
	https://www.sciencedirect.com/science/article/pii/B9780128197257001586#a0010

7	Prof SN Mukhopadhyay, FNAE, Adjunct Professor, Department of Biological Sciences, BITS, Pilani and Former Professor, DBEB, IIT Delhi; Former Professor & Head, BERC, IIT Delhi; Former Professor SOBT, GBU, Greater Noida, has received invitations and has forwarded abstracts which have been accepted for the following events. ➢ IconSWM-CE and IPL, December 2021 at Mechanical Engineering Department, Jadavpur University, Kolkata on Natural and Artificial Photosynthesis (NAP) in Treating Waste Materials". ➢ ICMS-ACMS 2022 to be organized by IIChE HQ, Kolkata in February 2022. Title of the abstract "LHGBRS PRSTEP aided by LPGBRS for AGOU and SGOE". ➢ Vidya Kutir Publications (VKP), Delhi, a book chapter for the book Advances in Atmospheric Research with title of abstract as "Discovered God Particles in Advancing Atmospheric Research". ➢ "God Particles (GPs) Regulated LHGBRs Exposures to Space Environment in their Space Ventures" which has been accepted for presentation at the International Conference on Space Tourism Centre for Aviation and Space Laws at NUJS, Kolkata being held in January 2022.
8	Prof. Prahlada Ramarao, FNAE, Padma Shri; Former Distinguished Scientist and Chief Controller, DRDO; Former Vice Chancellor, DIAT, Pune; Pro Chancellor, S-VYASA and Director, Centre for Energy Research, S-VYASA University, Bengaluru delivered an online Special lecture on the occasion of National Innovation Day (Former President Dr. A.P.J. Abdul Kalam's Birthday) on October 12, 2021 on "India warming up to cold fusion" organized by Centre for Nano and Soft Matter Sciences. As part of Azadi ka Amrit Mahotsav celebrations.
9	Mr S Somanath, FNAE Formerly Director, Vikram Sarabhai Space Centre; Former Director, Liquid Propulsion Systems Centre (LPSC), Trivandrum has taken over as the Chairman, Space Commission, Chairman, ISRO and Secretary, Department of Space, Government of India. Please see the link given below for Update from ISRO regarding the same.
	https://www.isro.gov.in/update/14-jan-2022/shri-s-somanath-assumes-charge-secretary-department-of-space
10	Prof Rangan Banerjee, FNAE, Forbes Marshall Chair Professor, Department of Energy Science and Engineering, Indian Institute of Technology Bombay, Mumbai has been appointed as Director of IIT Delhi. For news regarding the same please click on link given below.
	https://indianexpress.com/article/india/iit-delhi-gets-new-director-7716590/
11	Prof Laxmidhar Behera, FNAE, Poonam and Prabhu Goel chair professor of electrical engineering at the IIT, Kanpur has been appointed as Director, IIT Mandi as per news link given below.
	https://www.ndtv.com/education/iit-mandi-appoints-new-director-laxmidhar-behera-from-iit-kanpur-iitmandi-ac-in
12	Prof. Suhas Joshi, FNAE, Rahul Bajaj Chair Professor and Dean, Department of Mechanical Engineering, Indian Institute of Technology Bombay, Mumbai has been appointed as Director, IIT Indore. Further details may be viewed at the link given below.
	https://www.timesnownews.com/education/article/iit-indore-gets-a-new-director-all-you-need-to-know-about-professor-suhas-joshi/848368
13	Dr. BHVSN Murthy, FNAE, Distinguished Scientist and Director General (MSS), Ministry of Defence, DRDO delivered a Lecture on "Role of Artificial Intelligence in Missile Applications" on December 9, 2021.
14	Dr. Samir V Kamat, FNAE, Distinguished Scientist and Director General (Naval Systems & Materials), Ministry of Defence, DRDO delivered a Lecture on "Materials for Defence: Challenges and Opportunities" on 17th Jan 2022 through Online Video Conferencing (Webex Platform).

15	Mr S N Subrahmanyan, CEO & MD, Larsen & Toubro Ltd., Mumbai has been appointed one of nine founding members of Climate Finance Leadership Initiative (CFLI) India in recognition of L&T's leadership in climate and infrastructure finance. Mr Subrahmanyan has joined CFLI's CEO Forum, representing L&T, as one of the two corporate conglomerates outside the financial sector. This follows an announcement by the UN Special Envoy for Climate Action and Solutions, Mr Michael R Bloomberg.
16	Prof. Pradip K. Tewari, FNAE, Head, Department of Chemical Engineering, IIT Jodhpur delivered an online Lecture on "Water Issues in Rural Areas: IIT Jodhpur Interventions" during the Indian Women Scientists' Association (IWSA) is organizing 17th Talk under IWSA's Science and our Life Lecture Series on August 14, 2021.
17	Prof K. Ramesh, FNAE, K Mahesh Chair Professor, Department of Applied Mechanics, IIT Madras, Chennai has authored a book on "Developments in Photoelasticity - A Renaissance" published by IOP (Institute of Physics), UK. The details of the book can be seen in the link
	https://iopscience.iop.org/book/978-0-7503-2472-4 The book is of interest to Fellows in Mechanical, Civil, Aerospace and Agricultural Engineering Disciplines.
18	Dr. Debabrata Das, FNAE, Former Professor, Head and Renewable Energy Chair Professor, Department of Biotechnology, Former Professor-in-Charge, P K Sinha Center for Bioenergy, Indian Institute of Technology, Kharagpur delivered a plenary lecture on "BioHythane production using organic wastes: the path towards a sustainable future" in the third International Conference on "Recent advances in bio-energy research (ICRABR-2022)" on March11, 2022 held at Sardar Swaran Singh National Institute of Bio-Energy, Kapurthala.
19	Prof AB Pandit, FNAE, Vice-President, INAE and Vice-Chancellor, Institute of Chemical Technology, Mumbai has been named the number one scientist in India by Research.com closely followed by Professor of Chemical Engineering- Prof Parag Gogate, FNAE at number two and Professor of Eminence, Dr JB Joshi, FNAE, at number four. These ranking are based on a thorough study of the h-index, publications and citations values of over 10,875 scientists from Google Scholar and Microsoft Academic Graph.

Fellows Deceased in Last one Year

During the year 2021-2022, it was learnt about the sad demise of the following INAE Fellows. Deepest Condolences have been expressed to the families of the deceased Fellows on behalf of INAE and prayers were offered for their souls to rest in peace. Brief Obituaries as a mark of respect for the departed INAE Fellows are given below.

Obituaries

Prof Jyotirmay Majumder

(July 9, 1951 -April 10, 2021)

Prof Jyotirmoy Mazumder, FNAE born on July 9, 1951 passed away on April 10, 2021. He was elected to INAE Foreign Fellowship in the year 2020 and affiliated to Engineering Section VIII (Mining, Metallurgical and Materials Engineering).

Prof Jyotirmoy Mazumder Robert H Lurie Professor of Engineering and Director of Center for Laser Aided Intelligent Manufacturing, University of Michigan at Ann Arbor, USA had made significant research contributions in the areas of Laser Materials Processing and Additive Manufacturing. His directed basic research work led to the commercialization of Direct Metal Deposition technology and he had recently developed in-situ sensors for 3-D printing and welding that have the capability to detect defects, composition, and phase transformations. He invented First closed loop Direct Metal Deposition system.

May God Bless his Soul to Rest in Peace

Dr R Krishnan

(December 26, 1935 - April 16, 2021)

Dr R Krishnan, FNAE born on December 26, 1935 passed away on April 16, 2021. He was elected to INAE Fellowship in the year 1988 and affiliated to Engineering Section VIII (Mining, Metallurgical and Materials Engineering).

Dr R Krishnan, FNAE, formerly Director, Gas Turbine Research Establishment, DRDO and formerly Head, Metallurgy Division, BARC had made significant contributions in the areas of Physical Metallurgy and Material Sciences including X-ray metallography work for the study of textures in metallic uranium fuel elements. He participated in the 100MW Dhruva reactor fuel development activities. At GTRE, he was responsible for selection of high temperature materials for turbine applications. The structural metallurgy laboratory started by him at BARC has contributed greatly in understanding the behaviour of several metals and alloys.

May God Bless his Soul to Rest in Peace

Dr KN Raju

(April 27, 1936 -April 30, 2021)

Dr K N Raju, FNAE born on April 27, 1936 passed away on April 30, 2021. He was elected to INAE Fellowship in the year 1999 and affiliated to Engineering Section X (Interdisciplinary and Special Engineering Fields and Leadership in Academia, R&D and Industry).

Dr KN Raju, Formerly Director, National Aerospace Laboratories, Bangalore had made significant contributions towards Aerospace Research & Development and was an internationally known expert in the areas of Fatigue, Fracture and Structural Integrity of Aerospace Structures. He nurtured the field of Fatigue and Fracture Mechanics and was the principal architect in building Full Scale Aircraft Fatigue Test facility which has become a National Facility in India. He had successfully carried out development of the Light Combat Aircraft carbon composite wings from the conceptual stage, design activity and supervised fabrication of the first two prototypes.

May God Bless his Soul to Rest in Peace

Dr Sanjay Bajpai

(February 19, 1965 – May 12, 2021)

Dr Sanjay Bajpai, FNAE born on February 19, 1965 passed away on May 12, 2021. He was elected to INAE Fellowship in the year 2019 and affiliated to Engineering Section X (Interdisciplinary and Special Engineering Fields and Leadership in Academia, R&D and Industry).

Dr Sanjay Bajpai, Scientist-G, Department of Science and Technology (DST), Govt. of India had made significant R&D contributions in the areas Energy and Water. At DST, he conceptualised and steered various schemes particularly, State S&T mechanisms through application of appropriate technology development and commercialization endeavours. He was responsible for the field specific initiatives in the areas of water, biofuels and clean energy, whose outcome showed greater impact on people. He shaped a strong eco-system for R&D and technology demonstration in launching Clean Energy Research Initiative, with initial focus on Solar Energy.

May God bless his soul to Rest in Peace

Prof KL Chopra
(July 31, 1933 – May 19, 2021)

Prof KL Chopra, FNAE born on July 31, 1933 passed away on May 19, 2021. He was elected to INAE Fellowship in the year 1987 and affiliated to Engineering Section VIII (Mining, Metallurgical and Materials Engineering).

Prof KL Chopra, former Director, IIT Kharagpur and formerly IREDA Chair Professor, Centre for Energy Studies and Thin film Laboratory, Physics Department, IIT Delhi had made significant research contributions in the areas of Physics & Technology of Thin Films and Surface & Vacuum Science and was a distinguished physicist and administrator. He set up the Thin Film and Micro Science Laboratories at IIT Delhi and IIT Kharagpur respectively and contributed vastly to the fields of thin films, energy, and nano matter. He also researched at Fritz Haber Institute, Berlin, Philico-Ford Scientific Laboratory and was affiliated to R&D Groups at IBM and Westinghouse.

May God bless his soul to Rest in Peace

Dr Srikumar Banerjee
(April 25, 1946 – May 23, 2021)

Dr Srikumar Banerjee, FNAE born on April 25, 1946 passed away on May 23, 2021. He was elected to INAE Fellowship in the year 1993 and affiliated to Engineering Section VIII (Mining, Metallurgical and Materials Engineering).

Dr Srikumar Banerjee, Chancellor, Homi Bhabha National Institute, BARC, Mumbai and Formerly Director, Bhabha Atomic Research Centre, Mumbai; Formerly Chairman, Atomic Energy Commission and Secretary, DAE, Govt. of India had made significant research contributions in the areas of Phase Transformations, Physical Metallurgy and Electron Microscopy. As Director, BARC, he directed research in nuclear fuel cycle, design of innovative reactors, applications of radiation and isotope technology in agriculture, health care, food preservation and industry. He carried out pioneering work in the field of martensitic transformations, and nuclear structural materials.

May God bless his soul to Rest in Peace

Mr J Jayaraman
November 19, 1940 - May 29, 2021)

Mr J Jayaraman, FNAE born on November 19, 1940 passed away on May 29, 2021. He was elected to INAE Fellowship in the year 2001 and affiliated to Engineering Section VII (Aerospace Engineering).

Mr J Jayaraman, Formerly Scientist G, Associate Director, Aeronautical Development Establishment (ADE), Bangalore had made significant Research & Development contributions in the areas of Mechanical Engineering Systems and Airframe Design including development of metallic and composite airframes of UAVs. He made contributions in evolving and promoting integrated system design concepts for UAVs and contributed towards the development of the Pilotless Target Aircraft- Lakshya by Aeronautical Development Establishment as Project Director, leading to its successful completion and induction by Air Force.

May God Bless his Soul to Rest in Peace

Dr Gade Padmanabham
(August 10, 1964 - June 4, 2021)

Dr G Padmanabham, FNAE born on August 10, 1964 passed away on June 4, 2021. He was elected to INAE Fellowship in the year 2020 and affiliated to Engineering Section VIII Mining, Metallurgical and Materials Engineering).

Dr G Padmanabham, Director, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad had made significant research contributions in the areas of Materials Joining and Laser processing of material including Sol-Gel nanocomposite coatings and carbon materials. His helped transform the Laser Centre as a unique facility for addressing complex problems for application in automotive, aerospace, nuclear, power, defence and electronics sectors. As Director, ARCI he was responsible for development of technologies in the fields of engineering materials and additive manufacturing and its transfer to industry.

May God Bless his Soul to Rest in Peace

Dr. Sudhir B Koganti
(June 15, 1949 – June 7, 2021)

Dr Sudhir B Koganti, FNAE born on June 15, 1949 passed away on June 7, 2021. He was elected to INAE Fellowship in the year 2009 and affiliated to Engineering Section IX (Energy Engineering).

Dr Sudhir B Koganti, formerly Head, Reprocessing Research & Development Division, Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam had made significant research contributions in the areas of Separation Technology and Multiphase Flow. He made several innovative contributions towards the equipment development, multi-phase flow and modelling aspects of solvent extraction for spent fuel reprocessing of Uranium, Plutonium carbide fuel that has undergone burn up in Fast Breeder Reactor. His contributions paved the way to formulate the analysis code (SIMPEX) for high Plutonium content.

May God bless his soul to Rest in Peace

Dr Vijai Mohan Sharma
(January 6, 1939 – July 6, 2021)

Dr Vijai Mohan Sharma, FNAE born on January 6, 1939 passed away on July 6, 2021. He was elected to INAE Fellowship in the year 1995 and affiliated to Engineering Section I (Civil Engineering).

Dr Vijai Mohan Sharma, FNAE, Director, Advanced Technology & Engineering Services, Associated Instrument Manufacturers (India) Limited, (AIMIL), New Delhi and Formerly Director, Central Soil and Materials Research Station (CSMRS), New Delhi had made significant contributions in the areas of Rock Mechanics and Geotechnical Engineering. During his tenure at AIMIL, he contributed to major hydro-electric projects, tunnels and underground power houses and extended the scope of work to include Numerical Modelling, Reinforced Earth Technology and Non-Destructive Testing. He was associated with projects in the fields of Geotechnical Engineering, Rock Mechanics, Water Resources, Tunnelling, Field Instrumentation, Slope Stabilization & Numerical Modelling.

May God bless his soul to Rest in Peace

Prof. Jorg Michael Schlaich
(October 17, 1934 – September 4, 2021)

Prof. Jorg Michael Schlaich, a Foreign Fellow of INAE born on October 17, 1934 passed away on September 4, 2021. He was elected to INAE Fellowship in the year 2000 and affiliated to Engineering Section I (Civil Engineering).

Prof. Jorg Michael Schlaich, FNAE, co-founder, Schlaich Bergermann und Partner, Hohenzollernstr, Stuttgart, Germany and Formerly Director, Institute of Structural Design, University of Stuttgart, Germany was a reputed German structural engineer and was known internationally for his ground-breaking work in the creative design of bridges, long-span roofs, and other complex structures. He had made significant contributions in designing many notable structures including innovative roofs, bridges and towers. He was a particular advocate of lightweight

structures, highlighting a number of cultural, ecological and social benefits and emphasized that light structures are transparent and show the flow of forces in a natural way.

May God bless his soul to Rest in Peace

Dr A.M. Michael
(June 17, 1930 – November 12, 2021)

Dr A.M. Michael, FNAE born on June 17, 1930 passed away on November 12, 2021. He was elected to INAE Fellowship in the year 1987 and was affiliated to Engineering Section I (Civil Engineering).

Dr A.M. Michael, FNAE Formerly Vice Chancellor, Kerala Agricultural University and Director, IARI, New Delhi had made significant research contributions in the areas of Agricultural Engineering and Land and Water Resources Development which had a great impact on Indian agricultural research and development, irrigation engineering and Informatics. He was a distinguished agricultural scientist and an institution builder of renown. Apart from developing irrigation systems which could minimise water loss, he introduced the idea of Agricultural Informatics preparing the agricultural sector of India for the networked society. As the Vice-Chancellor of Kerala Agriculture University, he was instrumental in taking the varsity to greater heights of excellence.

May God Bless his Soul to Rest in Peace

Prof. Surjya Kumar Maiti
(July 29, 1948- December 2, 2021)

Prof Surjya Kumar Maiti, FNAE, born on July 29, 1948 passed away on December 2, 2021. He was elected to INAE Fellowship in the year 1997 and was affiliated to Engineering Section III (Mechanical Engineering).

Prof Surjya Kumar Maiti, FNAE, Visiting Professor, Mechanical Engineering Dept., IIT Bhilai, and former Professor, Mechanical Engineering Department, IIT Bombay, Mumbai had made significant research contributions in the areas of Fracture Mechanics covering stable and unstable crack growth, computational fracture mechanics, crack-crack interactions, residual stress effects, interface cracks in biomaterials & nondestructive detection of cracks and Finite element methods covering Elastic-plastic stress analysis, analysis of crack-stiffened panels, multiple points singularity element and thermal stress analysis. He had published about 100 papers in national and international journals.

May God Bless his Soul to Rest in Peace

Prof. KN Seetharamu
(August 22, 1939 - January 16, 2022)

Prof KN Seetharamu, FNAE, born on August 22, 1939 passed away on January 16, 2022. He was elected to INAE fellowship in the year 2010 an affiliated to Engineering Section III (Mechanical Engineering).

Prof KN Seetharamu, FNAE Chair Professor in Thermal Engg., Dept of Mechanical Engg., PESIT, Bangalore and former Professor, IIT Madras had made significant research contributions in the field of heat transfer. He had an industrial experience of more than three years in a paper mill before he joined the academic life. His areas of interest were heat transfer, fluid flow, stress analysis, energy systems, electronic packaging, and FEM applications to engineering problems. He was also working on the application of ANN and GA for optimization problems. He had contributed extensively in the areas of Porous Medium, Heat Exchangers, Thermal Management in Electronic Systems etc. He was active in the application of FEM to CFD and Financial Problems.

May God Bless his Soul to Rest in Peace

Dr Subir Kumar Bhattacharyya
December 25, 1945 – February 1, 2022)

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

Dr Subir Kumar Bhattacharyya, FNAE, Former Director, SAIL, Ranchi and former Managing Director, Durgapur Steel Plant had made significant contributions in the field of Metallurgical Engineering. He was a former President (2003-2004) of the Indian Institute of Metals. The development of Hadfield Steel Plates and coloured stainless steels were some of his notable achievements. He took charge as the Managing Director of Durgapur Steel Plant in 2001 and played a major role in turning the loss-making plant into a profit-making vibrant Organization. Under his leadership, the rated capacities of major shops were surpassed while there were improvements also in the major techno-economic parameters.

May God Bless his Soul to Rest in Peace

Prof Rajinder Kumar
(September 9, 1934- February 7, 2022)

Prof Rajinder Kumar, FNAE born on September 09, 1934 passed away on February 7, 2022. He was elected to INAE Fellowship in the year 1987 and was affiliated to Engineering Section IV (Chemical Engineering).

Prof Rajinder Kumar, FNAE, Professor, Department of Chemical Engineering, Indian Institute of Science, Bangalore and Honorary Professor at JNCASR had made significant research contributions in the field of Chemical Engineering including Multiphase Phenomena. He was among the pioneering contributors to an analytical approach to chemical engineering problems. His various contributions on multiphase phenomena, in particular bubble and drop phenomena, sonochemistry, foam beds are well cited and have inspired further research. A feature of his approach in research was a keen awareness of the practical angle along with theoretical concepts. He was conferred with Padma Bhushan by President of India in 2003.

May God bless his soul to Rest in Peace.

Mr Vijai Kumar Agarwal
(August 11, 1940 – February 14, 2022)

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

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

May God Bless his Soul to Rest in Peace

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

(February 07, 1941 - February 17, 2022)

Dr. T.V.S.R. Appa Rao, FNAE, born on February 07, 1941 passed away on February 17, 2022. He was elected to INAE Fellowship in the year 1990 and was affiliated to Engineering Section I (Civil Engineering).

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

May God Bless his Soul to Rest in Peace

INAE Annual Convention

INAE Annual Convention 2021

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

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

Presidential Address delivered by Prof Indranil Manna, President, INAE.

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

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

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

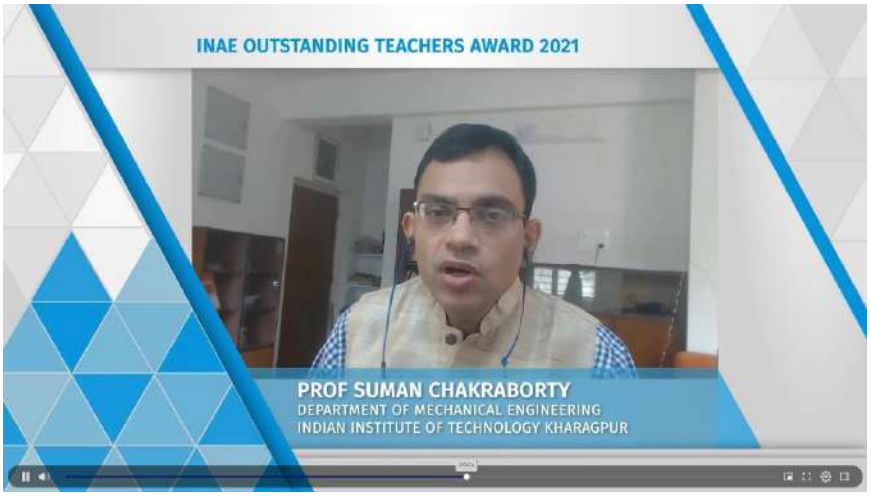
Vote of Thanks proposed by Prof Purnendu Ghosh, Vice-President, INAE

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

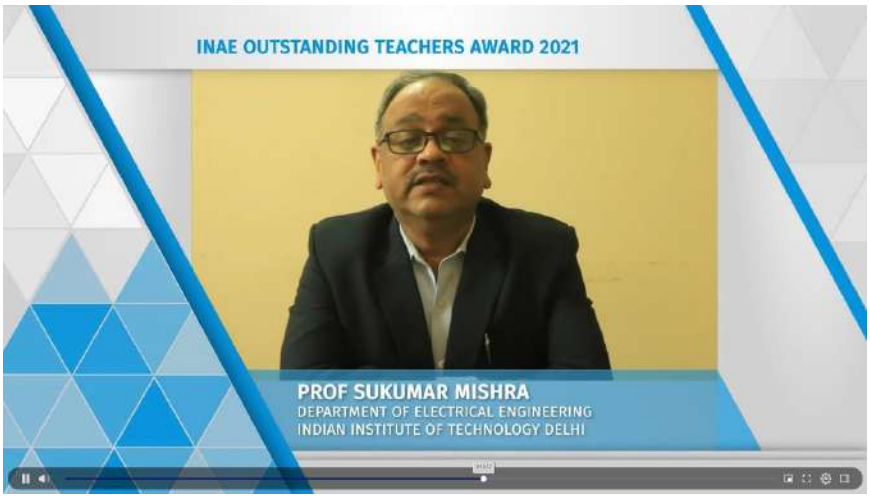
INAE Women of the Year Award 2021 was awarded in three categories, Academia, R&D and Industry. Ms Vartika Shukla, CMD, Engineers India Limited, Delhi, the Woman Engineer of the Year Awardee 2021 (Industry Category) delivering her award acceptance speech

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

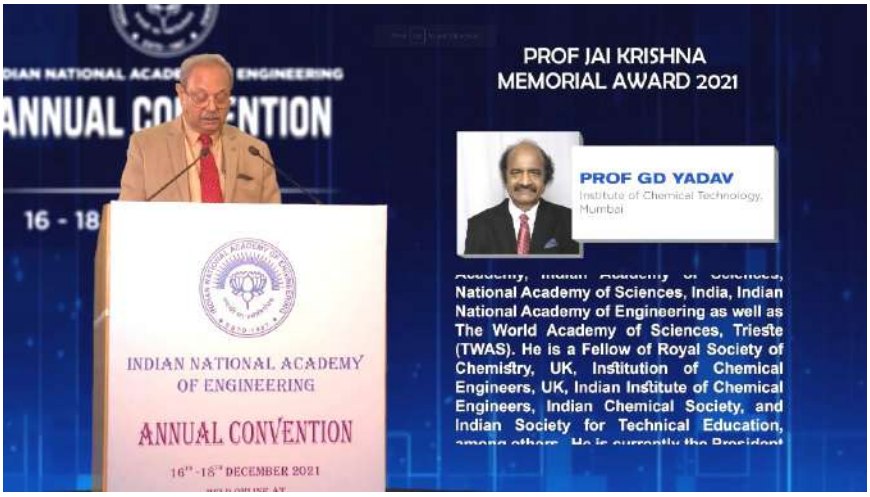
Smt Madhumita Chakravarti, Director, CMSDS, Kolkata, the Woman Engineer of the Year Awardee 2021 (R&D Category) delivering her award acceptance speech



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

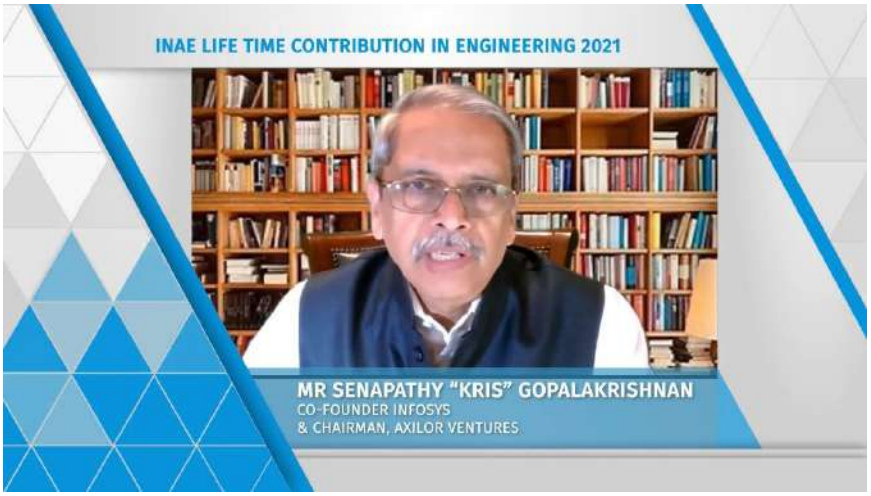


Prof Sukumar Mishra, Department of Electrical Engineering, Indian Institute of Technology Delhi-INAE Outstanding Teachers Awardee for the year 2021 delivering his award acceptance speech

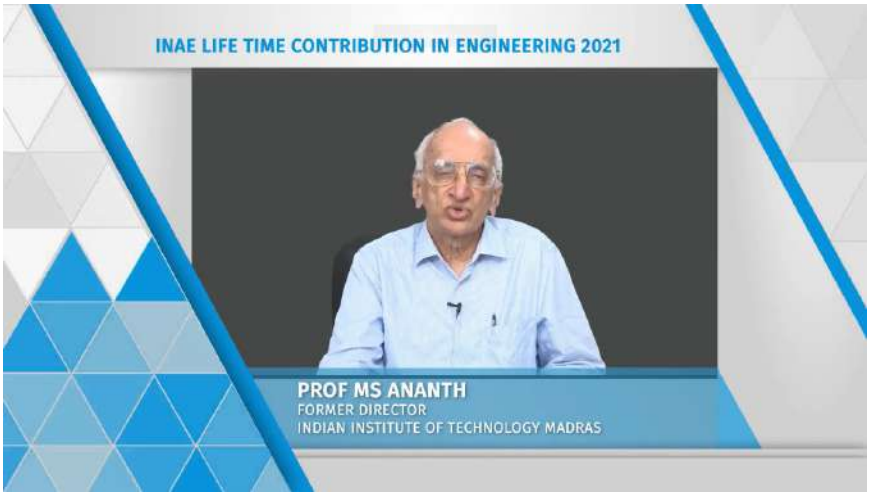


Prof Jai Krishna Memorial Award 2021 awarded to Prof GD Yadav, Emeritus Professor of Eminence and JC Bose National Fellow, Former Vice Chancellor; Institute of Chemical Technology, Mumbai

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



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



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

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

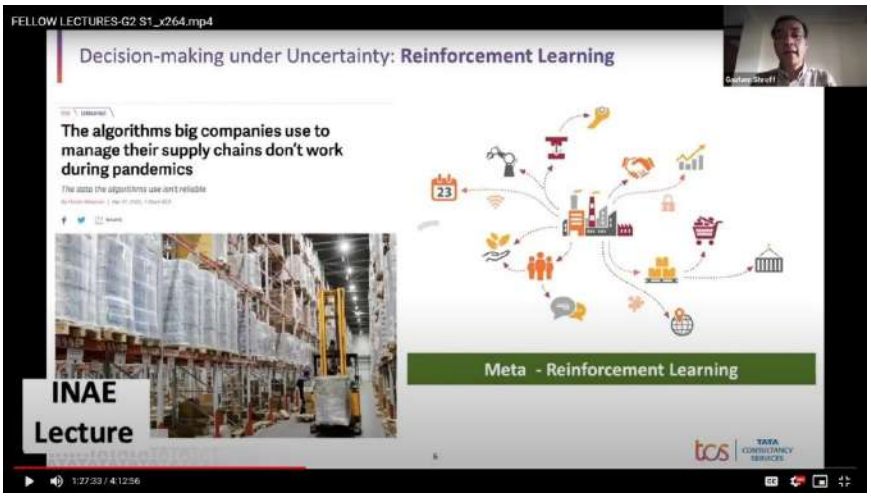
On the last day i.e., December 18, 2021, the Induction Ceremony of Fellows & Young Associates was held at 7.30 AM followed by the Pre-recorded Technical Presentations by newly elected Fellows & Foreign Fellows by 44 newly inducted Fellows & Foreign Fellows in four parallel sessions on various topics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

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

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

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

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



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

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

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

Parallel Sessions (Engineering Sections Group-1)-Parallel Sub-Session-2 (ES-VII and VIII)

https://www.youtube.com/watch?v=rOn3dEVPsvU

Parallel Sessions (Engineering Sections Group-2)- Parallel Sub-Session-3 (ES-II, V and VI)

https://www.youtube.com/watch?v=5eu7w7y--Ik

Parallel Sessions (Engineering Sections Group-2)- Parallel Sub-Session-4 (ES-IX and X)

https://www.youtube.com/watch?v=AmR203R55tI

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

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

Parallel Session 2 (Engineering Sections Group-2) -Parallel Session 2 (ES-II, V, VI, IX and X)

https://www.youtube.com/watch?v=wILYQkLlXfk

Publications of the Academy

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

INAE is currently publishing a Journal named "Transactions of Indian National Academy of Engineering – International Journal of Engineering and Technology" published by M/s Springer which was earlier named INAE Letters. 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. During the last year, four issues of the Transactions of INAE Journal were brought out in June 2021; September 2021; December 2021 and March 2022. The December 2021 issue was dedicated to the theme of "Additive Manufacturing".

Book titled "Making of a Satellite Centre: The Genesis of ISRO's UR Rao Satellite Centre" authored by Dr. PS Goel

Book titled "Making of a Satellite Centre: The Genesis of ISRO's UR Rao Satellite Centre" is authored by Dr Prem Shanker Goel, former President, INAE and former Secretary, Ministry of Earth Sciences and Chairman, Earth Commission and Director, ISRO Satellite Centre, Bangalore. The book was published by Springer and tells the story of the evolution of the Satellite Center which started from a small Satellite Systems Division in 1967 with a handful of engineers to a vibrant R&D center which is playing the lead role in the Indian Satellite Program. India's space program is unique as it is driven by societal applications. The ISRO Satellite Centre, now known as the UR Rao Satellite Centre (URSC), has evolved as lead center for Satellite Technology over five decades and has developed state-of-the-art satellites for applications such as remote sensing, satellite communication and space science. Through the story of URSC, the book describes the challenges of putting together new research and development centers and programs and conveys the importance of leadership and project management skills required to undertake such a task.

Miscellaneous News of INAE

Vigilance Awareness Week Celebrations by INAE on Oct 26-Nov 1, 2021

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

Training Programmes attended by INAE Staff

Training of the trained employees is crucial for achieving excellence in organizational operations. Keeping this in view, INAE staff are encouraged to attend regular training programs for knowledge upgradation and keeping pace with changing technologies and administrative policies. In the financial year 2021-22, INAE staff participated in the following training programs.

Half-day Online Training programme on "Right to Information Act: 2005" through Virtual platform was conducted by National Productivity Council, Jaipur on May 20, 2021. Ms. Hema Gupta, Sr. Assistant Grade-I was nominated to attend the programme. Sh PCP Mahapatra, Professional Trainer explained the various aspects of Right to Information Act: 2005 and elaborated on the duration for which respective records are to be mandatorily maintained. Further, Mr. Mahapatra explained the importance and process of appropriate record keeping.

Two days' Online Training programme on "E-Procurement Procedures & E-Tendering in Public Procurement: complexities & Govts Provision for MII & MSMES" through Virtual platform was conducted by National Productivity Council, Jaipur on Oct 28-29, 2021. Mr. Gaurav Kandalgaonkar, Assistant Grade-II was nominated to attend the programme. The program included various aspects of inventory management, steps of procurement, tendering process and utilizing e-tendering tools for public procurement. The trainers also gave insight to procurement through GeM portal with special emphasis to complexities in procurement and provisions for procurement through MII and MSMEs.

One day Online Training programme on "Implementation of EAT Module" through Virtual platform was conducted by Department of Expenditure, Controller General of Accounts, Public Financial Management System, New Delhi on Nov 17, 2021. Mr Bhuwan Adhlakha, Manager (F&A) was nominated to attend the programme. The trainers gave detailed demonstration on the steps to be followed for implementation of Expenditure, Advance and Transfer module (EAT Module) and why it is important to implement the same by all the Government sector organizations.

12 days' (11 webinars) on Procurement (Policy & Procedures based on GFR, GeM & E-Procurement) and Contract Management for Good Governance: Challenges in Implementation" through Virtual platform was conducted by Indian Institute of Corporate Affairs, Under Ministry of Corporate Affairs on Feb 1-12, 2022. Lt Col Shobhit Rai (Retd), Deputy Executive Director attended the programme to gain insight into the complexities of procurement as per provisions of GFR, GeM and E-procurement. The program included the theoretical fundamentals as well as the practical situations faced at the time procurement of different category of products, services and contracts. The program also envisaged good governance in contract management of different durations.

5 days' residential training programme on "Building Confidence for Personal" was held at Art of Living International Centre, Bengaluru. Department of Science and Technology had sponsored this Training Program for Scientists and Technologists of Government Sector. Ms. Pratigya Laur, Research officer was nominated to attend the programme. During this residential programme, the participants were trained on various Kriyas with an aim to maintain good physical and emotional health through Yoga, meditation exercises and musical notes. The trainers in various sessions explained how physical exercises, spiritual thinking and musical sounds relieve stress and help in acquiring balance in life.

Donations/voluntary contributions offered by INAE Fellows

The Academy place on record its deep appreciation and generously acknowledge the receipt of donations / voluntary contributions received from the following Fellows of the Academy during the financial year 2021-22.

(a) USD 1,000/- equivalent to Rs.74000/- received from Dr. Raymond S Stata, Foreign Fellow of INAE.

(b) Mr. Senapathy 'Kris' Gopalakrishnan, FNAE donated Rs. 5,00,000/- to INAE as contribution to INAE Corpus.

(c) Prof. JB Joshi, FNAE donated an amount of Rs. 2,00,000/- to INAE as a voluntary contribution.

INAE is recognized under section 12A of Income Tax Act, 1961 as per Registration no. AAAAI0043AE19902 dated 24.09.2021 and is also registered under section 80G of Income Tax Act, 1961 as per order no. AAAAI0043AF20213 dated 31.12.2021, under which the contributors are eligible to get a deduction for 50% of the contributions made to INAE from the total income.

Handing over of INAE assets of its office at Vishwakarma Bhawan New Delhi to IIT Delhi

In view of allotment of permanent office space to INAE in Technology Bhawan, New Delhi by DST, the Academy had decided to shift the previous registered office of INAE to Technology Bhawan, DST, New Delhi. It was also decided that INAE office at Vishwakarma Bhawan lying vacant be handed over to IIT Delhi with an offer to take over the assets as per the depreciated book value. IIT Delhi had decided to hand over this office to I-Hub Foundation of Cobotics (IHFC) and IHFC had expressed its willingness to take over the said assets at depreciated book value, the INAE Finance Committee during its recent meeting on 11th March 2022 recommended to hand over the said assets to IHFC through IIT Delhi with the approval of Governing Council. The said premises of INAE at Vishwakarma Bhawan was handed over to IHFC through IIT Delhi with the approval of INAE Governing Council.

Statement of Accounts
2021-22

Indian National Academy of Engineering

P. K. Gaur & Associates
Chartered Accountants

Suite #4G, Uppal's M6 Plaza,
Jasola District Centre,
New Delhi - 110025, INDIA
Tel. : +91 11 40528391 - 94
www.pkgassociates.in

Independent Auditor's Report

To
The Members
Indian National Academy of Engineering
Technology Bhawan,
New Delhi-110016

Opinion

We have audited the financial statements of **M/s Indian National Academy of Engineering**, which comprise the balance sheet at March 31st 2022 and also the Income and Expenditure Account for the year then ended and notes to the financial statements, including a summary of significant accounting policies.

In our opinion, the accompanying financial statements give a true and fair view in accordance with the accounting principles generally accepted in India of the financial position of the entity as at March 31, 2022 and of it's excess of income over expenditure for the year ended of that date.

Basis for Opinion

We conducted our audit in accordance with the Standards on Auditing (SAs) issued by ICAI. Our responsibilities under those standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are independent of the Society in accordance with the ethical requirements that are relevant to our audit of the financial statements in [jurisdiction], and we have fulfilled our other ethical responsibilities in accordance with these requirements. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Management's Responsibility for the Financial Statements

Management is responsible for the preparation of these financial statements that give a true and fair view of the financial position and incomes and expenditures of the Society in accordance with the accounting principles generally accepted in India, including the Accounting Standards, to the extent applicable, issued by the Institute of Chartered Accountants of India including the relevant provisions of the Act and Rules. This responsibility also includes maintenance of adequate accounting records for safeguarding the assets of the Society and for preventing and detecting frauds and other irregularities: selection and application of appropriate accounting policies; making judgments and estimates that are reasonable and prudent; and design, implementation and maintenance of adequate internal controls that were operating effectively for ensuring the accuracy and completeness of the accounting records, relevant to the preparation and presentation of the financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, the management are responsible for assessing the Society's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the Members either intend to liquidate the Society or to cease operations, or have no realistic alternative, but to do so.

Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

For **P. K. Gaur & Associates**
Chartered Accountants
Firm's Registration No.: 005311N

Mayank Gaur
Partner
Membership No.: 518183
UDIN: 22518183ALVZEA7551

Place: New Delhi
Date: 23-June-2022

INDIAN NATIONAL ACADEMY OF ENGINEERING, NEW DELHI

BALANCE SHEET AS AT 31ST MARCH, 2022

	Schedule	Current Year 2021-22	Previous Year 2020-21
CORPUS/CAPTAL FUND AND LIABILITIES			
CORPUS/ GENERAL FUND	1	1179,82,891	1135,57,837
RESERVE AND SURPLUS	2	-	-
EARMARKED/ ENDOWMENT FUNDS	3	26,12,330	25,43,651
SECURED LOANS AND BORROWINGS	4	-	-
UNSECURED LOANS AND BORROWINGS	5	-	-
DEFFERED CREDIT LIABILITIES	6	-	-
CURRENT LIABILITIES AND PROVISIONS	7	2895,54,414	553,30,109
Total		4101,49,635	1714,31,597
ASSETS			
FIXED ASSETS	8	201,20,936	227,99,460
INVESTMENTS - FROM EARMARKED/ENDOWMENT FUNDS	9	-	-
INVESTMENTS - OTHERS	10	972,00,000	957,00,000
CURRENT ASSETS, LOANS, ADVANCES ETC.	11	2928,28,699	529,32,137
MISCELLANEOUS EXPENDITURE(to the extent not written off or adjusted)		-	-
Total		4101,49,635	1714,31,597
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LAIBILITIES AND NOTICES ON ACCOUNTS	25		

As per our report of even date

For P. K. Gaur & Associates
Chartered Accountants
Firm Reg. No. - 005311N

P.K. GAUR & ASSOCIATES Chartered Accountants NEW DELHI

Mayank Gaur
Partner
Membership No. 518183
Place: New Delhi
Dated: 23/6/2022

Manager (F & A)

On behalf of the Council:

President : 23.6.22

Vice-President .....
(Finance & Establishment)

Deputy Executive Director .....

INDIAN NATIONAL ACADEMY OF ENGINEERING, NEW DELHI

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2022

INCOME	Schedule	Current Year 2021-22	Previous Year 2020-21
Income from Sales/Services	12	-	-
Grants / Subsidies	13	1071,94,469	760,07,719
Fees/ Subscriptions	14	-	-
Income from Investments	15	24,45,100	26,76,610
Income from Royalty, Publication etc.	16	3,98,357	82,878
Interest Earned	17	35,60,976	42,86,467
Other Income	18	1,33,865	1,45,881
Withdrawal from Corpus Fund (reference Schedule-1)		-	-
Increase/(decrease) in stock of Finished goods and work-in-progress	19	-	-
Total (A)		1137,32,767	831,99,555
EXPENDITURE			
Establishment Expenses	20	180,78,052	151,59,396
Other Administrative Expenses etc.	21	44,18,427	37,36,773
Expenditure on Engineering Programes and Activities	21-A		
i) Seminars / Conferences / Symposiums / Workshops		14,44,593	81,609
ii) INAE Chair , Distinguished Professors & Mentoring Schemes		19,40,679	11,19,925
iii) Research Studies/ Projects		27,25,051	21,50,791
iv) INAE Awards		49,65,000	46,10,000
v) Academia-Industry Interaction AICTE-INAE Schemes		28,91,430	41,49,211
vi) INAE Forums		-	11,987
vii) Academy Meetings		4,61,963	80,621
viii) Annual Convention		14,62,739	15,76,331
ix) International Affairs		9,71,318	-
x) INAE Publications		72,870	3,49,598
xi) Financial Assistance for Engineering Activities		-	-
xii) SERB-INAE Abdul Kalam Technology Innovation National Fellowship		649,25,167	418,73,909
xiii) INAE Digital Platform		24,57,638	9,62,355
Expenditure on Grants, Subsidies etc.	22	-	-
Interest	23	1,77,300	6,47,782
Depreciation (Net Total at the year end - corresponding to Schedule 8)		23,07,400	25,75,298
Total (B)		1092,99,627	790,85,586
Balance being excess of Income over expenditure (A-B)		44,33,140	41,13,969
Transfer to DKRC Development Fund		68,679	66,873
Transfer to Corpus Fund		23,76,421	26,09,737
Transfer to Fixed Assets (Grant utilised for Capital Assets)		4,39,407	3,73,972
BALANCE BEING SURPLUS / (DEFICIT) CARRIED TO GENERAL FUND		15,48,633	10,63,387
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

As per our report of even date

For P. K. Gaur & Associates
Chartered Accountants
Firm Reg. No. - 005311N

Mayank Gaur
Partner
Membership No. 518183
Place: New Delhi

P. K. GAUR & ASSOCIATES Chartered Accountants NEW DELHI

Manager (F & A)

On behalf of the Council:

President 23-6-22

Vice-President (Finance & Establishment)

Deputy Executive Director

INDIAN NATIONAL ACADEMY OF ENGINEERING, NEW DELHI

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2022

SCHEDULE 1 - CORPUS/GENERAL FUND	General Fund 2021-22	INAE Corpus Fund 2021-22	General Fund 2020-21	INAE Corpus Fund 2020-21	Total 2021-22	Total 2020-21
Balance as at beginning of the year	658,00,268	477,57,569	647,66,874	451,47,832	1135,57,837	1099,14,706
Less : Unspent balance of PURA Project . to TIFAC	-		29,993		-	29,993
Add : Corpus received						
Transferred (to)/from Income and Expenditure A/c	15,48,633	23,76,421	10,63,387	26,09,737	39,25,054	36,73,124
Contibuton for INAE Corpus Funds	-	5,00,000			5,00,000	-
BALANCE AT THE YEAR END	**673,48,901**	**506,33,990**	**658,00,268**	**477,57,569**	**1179,82,891**	**1135,57,837**

(Bhuwan Adhlakha)
Manager (F&A)

P.K. GAUR & ASSOCIATES Chartered Accountants NEW DELHI

INDIAN NATIONAL ACADEMY OF ENGINEERING, NEW DELHI

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2022

SCHEDULE 2 - RESERVES AND SURPLUS :	Current Year 2021-22		Previous Year 2020-21	
1. Capital Reserve				
As per last Account	-		-	
Addition during the year	-		-	
Less: Deductions during the year	-	-	-	-
2. Revaluation Reserve :				
As per last Account	-		-	
Addition during the year	-		-	
Less: Deductions during the year	-	-	-	-
3. Special Reserves				
As per last Account	-		-	
Addition during the year	-		-	
Less: Deductions during the year	-	-	-	-
4. General Reserve				
As per last Account	-		-	
Addition during the year	-		-	
Less: Deductions during the year	-	-	-	-
Total		Nil		Nil

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INDIAN NATIONAL ACADEMY OF ENGINEERING, NEW DELHI

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2022

SCHEDULE 3- EARMARKED/ENDOWMENT FUNDS	Current Year 2021-22	Previous Year 2020-21
DKRC Development Fund		
a. Opening balance	25,43,651	24,76,778
b. Additions to the funds		
i Transferred (to)/from Income and Expenditure A/c	68,679	66,873
c. Utilisation for the purpose	-	-
BALANCE AT THE YEAR END Total : (a+b)	**26,12,330**	**25,43,651**

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Chartered Accountants
NEW DELHI

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SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2022

SCHEDULE 4 - SECURED LOANS AND BORROWING:	Current Year 2021-22		Previous Year 2020-21	
1. Central Government		-		-
2. State Government (Specify)				
3. Financial Institutions		-		-
a) Term Loans	-		-	
b) Interest accrued and due	-	-	-	-
4. Banks :				
a) Term Loans	-		-	
- Interest accrued and due	-		-	
b) Other Loans (Specify	-		-	
- Interest accrued and due	-	-	-	-
5. Other Institutions and Agencies		-		-
6. Debentures and Bonds		-		-
7. Others (Specify		-		-
Total		Nil		Nil
Note : Amounts due within one year				

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SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2022

SCHEDULE 5 - UNSECURED LOANS AND BORROWING:	Current Year 2021-22	Previous Year 2020-21
1. Central Government	-	-
2. State Government (Specify)	-	-
3. Financial Institutions	-	-
a) Term Loans	-	-
b) Interest accrued and due	-	-
4. Banks :		
a) Term Loans	-	-
b) Other Loans (Specify	-	-
5. Other Institutions and Agencies	-	-
6. Debentures and Bonds	-	-
7. Fixed Deposits	-	-
8. Others (Specify	-	-
Total	Nil	Nil
Note : Amounts due within one year		

SCHEDULE 6 - DEFFERED CREDIT LIABILITIES:	Current Year 2021-22	Previous Year 2020-21
a) Acceptance secured by hypothecation of capital equipment and other assets	-	-
b) Others	-	-
Total	Nil	Nil
Note : Amounts due within one year		

P.K. GAUR & ASSOCIATES Chartered Accountants NEW DELHI

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INDIAN NATIONAL ACADEMY OF ENGINEERING, NEW DELHI

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2022

SCHEDULE 7 - CURRENT LIABILITIES AND PROVISIONS	Current Year 2021-22		Previous Year 2020-21	
A. CURRENT LIABILITIES				
1 Salary Payable	-		-	
2. TDS Payable	79,241		50,978	
3. Expenses/Bills Payable	7,99,116	8,78,357	2,96,355	3,47,333
4. Audit Fee Payable		70,800		70,800
5. Unspent DST Grant	121,46,928		209,04,275	
6. Unspent AICTE Grant for DVP Scheme	31,63,472		57,85,957	
7. Unspent AICTE Grant for Travel Grant Scheme	8,95,437		27,53,250	
8. Unspent Earmarked SERB Grant for Digital Gaming Initiative	2500,00,000			
9. Unspent Earmarked SERB Grant for Colaborative Activities	75,00,000			
10. Unspent Earmarked SERB Grant for Abdul Kalam T. Innovation National Fellowship	4,39,947	2741,45,785	125,94,258	420,37,740
B. PROVISIONS				
1 Provision for Gratuity		76,34,412		68,04,319
2 Provision for Leave Encashment		68,25,060		60,69,917
Total		**2895,54,414**		**553,30,109**

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SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH , 2022

SCHEDULE 8 - FIXED ASSESTS

Description	Original cost of Asset as on 01.04.21	Asset Purchased during the year	Value of assets Disposed off/ sold	Original cost of Asset as on 31.03.22	Total Dep. Upto 01.04.21	Dep. for the Year 2021-22	Depriciation on Aseets Disposed off / sold	Utilisation of Grant u/s 11(1)	Total up to 31.03.22	Net Block of Asset as at 31.03.22	Net Block of Asset as at 31.03.21
	1	2	3	4	5	6	7	8	9	10	11
A. FIXED ASSETS											
Part -I Equipments	5831686	13990	774267	5071409	4912767	140784	725381	13990	4342160	729249	918919
Part - II Furniture	13961692	37787	650847	13348632	10204758	375693	546352	37787	10071886	3276746	3756934
Part - III Building	53741479	0	0	53741479	35835989	1790549	0	0	37626538	16114941	17905490
Part-V Sofrware -Digital Plateform	5377970	387630	0	5765600	5377970	0	0	387630	5765600	0	0
	78912827	**439407**	**1425114**	**77927120**	**56331484**	**2307026**	**1271733**	**439407**	**57806184**	**20120936**	**22581343**
Part-IV Equipments out of Project Grant	44744	0	44744	0	41682	374	42056	0	0	0	3062
Total :	**78957571**	**439407**	**1469858**	**77927120**	**56373166**	**2307400**	**1313789**	**439407**	**57806184**	**20120936**	**22584405**
B. CAPITAL WORK-IN-PROGRESS											
Sofrware -Digital Plateform	-	-	-	-	-	-	-	-	-	-	2,15,055
TOTAL	**78957571**	**439407**	**1469858**	**77927120**	**56373166**	**2307400**	**1313789**	**439407**	**57806184**	**20120936**	**22799460**

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SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2022

SCHEDULE 9 - INVESTMENT FROM EARMARKED/ENDOWMENT FUNDS	Current Year 2021-22	Previous Year 2020-21
1 Others (Term Deposit with SBI)	-	-
Total	-	-

SCHEDULE 10 - INVESTMENTS - OTHERS	Current Year 2021-22	Previous Year 2020-21
1 Corpus Fund (Term Deposit with SBI)	472,00,000	462,00,000
2 Others (Term Deposit with SBI)	500,00,000	495,00,000
Total	**972,00,000**	**957,00,000**

P.K. GAUR & ASSOCIATES Chartered Accountants NEW DELHI

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SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2022

SCHEDULE 11 - CURRENT ASSETS, LOANS, ADVANCES ETC.	Current Year 2021-22		Previous Year 2020-21	
A. CURRENT ASSETS:				
1 Cash balances in hand (Including Cheque/ Draft, Revenue Stamps and Imprest)		29,447		16,506
2 Bank Balance:				
a) With Scheduled Banks:				
- On Current Accounts	-		-	
- On Saving Account	2836,67,831	2836,67,831	451,66,766	451,66,766
Total (A)		**2836,97,278**		**451,83,272**
B. LOAN, ADVANCES AND OTHER ASSETS (Unsecured Considered Good)				
1 Advances and other amounts recoverable in cash or in kind or for value to be received:				
a) Pre payments	2,13,848		2,25,994	
b) Adcance to Expert Groups	28,34,332		14,95,676	
c) Others	7,33,182	37,81,362	19,46,833	36,68,503
2 Income Accured				
a) On Investment from Earmarked/Endowment Funds	-		-	
b) On investments - others	44,13,132	44,13,132	29,93,919	29,93,919
3 Claims Receivable				
a) TDS Receivable	8,98,427		10,47,943	
b) Security Deposit	38,500	9,36,927	38,500	10,86,443
Total (B)		**91,31,421**		**77,48,865**
Total (A+B)		**2928,28,699**		**529,32,137**

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SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 31ST MARCH, 2022

SCHEDULE 12 - INCOME FROM SALES/SERVICES	Current Year 2021-22	Previous Year 2020-21
1) Income from Sales		
a) Sale of Finished Goods	-	-
b) Sale of Raw Material	-	-
c) Sale of Scrap	-	-
		-
2) Income from Services		
a) Labour and Processing Charges	-	-
b) Professional /Consultancy Services	-	-
c) Agency Commission and Brokerage	-	-
d) Maintenance Services (Equipment/Property)	-	-
e) Others (Specify)	-	-
Total	Nil	Nil

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INDIAN NATIONAL ACADEMY OF ENGINEERING, NEW DELHI

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 31ST MARCH, 2022

SCHEDULE 13 - GRANTS/SUBSIDIES (Irrevocable Grants & Subsidies Received)	Current Year 2021-22	Previous Year 2020-21
1 Central Government	391,03,872	298,72,493
2 Government Agencies	678,16,597	460,23,120
3 International Organisations	74,000	72,106
4 Other		
- Contribution received by Bangalore Chapter from ADA	-	40,000
- Contribution from Fellows	2,00,000	-
Total	1071,94,469	760,07,719

SCHEDULE 14 - FEES/SUBSCRIPTIONS	Current Year 2021-22	Current Year 2020-21
1 Seminar/Program Fees		
Registration fee	-	-
Total	-	-
Note - Accounting policies towards each item are to be disclosed		

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SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 31ST MARCH, 2022

SCHEDULE 15 - INCOME FROM INVESTMENTS (Income on Invest.from Earmarked/Endowment Funds transferred to funds)	Investment from Earmarked Fund		Investment - Others	
	Current Year 2021-22	Previous Year 2020-21	Current Year 2021-22	Previous Year 2020-21
1 Others (Interest from Term Deposit)	68,679	66,873	23,76,421	26,09,737
Total	**68,679**	**66,873**	**23,76,421**	**26,09,737**
TRANSFERRED TO EARMARKED/ENDOWMENT FUNDS	68,679	66,873	23,76,421	26,09,737

SCHEDULE 16 - INCOME FROM ROYALTY, PUBLICATION ETC.	Current Year 2021-22	Previous Year 2020-21
1) Income from Royalty	3,98,357	82,878
Total	**3,98,357**	**82,878**

SCHEDULE 17 - INTEREST EARNED.	Current Year 2021-22	Previous Year 2020-21
1) On Term Deposits:		
a) With Scheduled Banks	24,36,309	26,74,884
2) On Savings Accounts:		
a) With Scheduled Banks	11,24,667	16,11,583
Total	35,60,976	42,86,467
Note - Tax deducted at source to be indicated	2,43,631	2,00,616

SCHEDULE 18 - OTHER INCOME.	Current Year 2021-22	Previous Year 2020-21
1) Profit on Sale/disposal of Assets: (Net)		
a) Owned Assets	(3,119)	-
2) Miscellaneous Income	1,36,984	1,45,881
Total	1,33,865	1,45,881

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SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 31ST MARCH, 2022

SCHEDULE 19 - INCREASE/(DECREASE) IN STOCK OF FINISHED GOODS & WORK IN PROGRESS .	Current Year 2021-22	Previous Year 2020-21
a) Closing Stock		
- Finished Goods	-	-
- Work-in-progress	-	-
b) Less: Opening Stock		
- Finished Goods	-	-
- Work-in-progress	-	-
NET INCREASE/(DECREASE) [a-b]	Nil	Nil

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INDIAN NATIONAL ACADEMY OF ENGINEERING, NEW DELHI

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 31ST MARCH, 2022

SCHEDULE 20 - ESTABLISHMENT EXPENSES.	Current Year 2021-22	Previous Year 2020-21
1 Salaries and Wages	152,79,889	142,67,952
2 Interim Relief paid - pending release of grant of 7th CPC	-	7,90,695
3 Contribution to NPS/PPF	13,22,859	13,13,067
4 Contribution to Gratuity and Leave Encashment	26,06,208	(41,269)
5 Staff Welfare Expenses	29,750	80,500
6 Leave Travel Concession (LTC)	1,67,510	2,31,746
Sub-total	194,06,216	166,42,691
Less: Establishment Expenses/Interim relief debited to AICTE Schemes	3,28,164	4,83,295
Less: Establishment Expenses/Interim relief & salary debited to SERB -Abdul Kalam TI National Fello	10,00,000	10,00,000
Total	**180,78,052**	**151,59,396**

SCHEDULE 21 - OTHER ADMINISTRATIVE EXPENSES ETC.	Current Year 2021-22	Previous Year 2020-21
1 Electricity and power	1,77,678	2,80,312
2 Water Charges	1,272	1,284
3 Insurance	31,285	31,268
4 Repairs and maintenance	21,47,502	24,63,968
5 Rent, Rates and Taxes	1,04,672	1,43,095
6 Postage, Telephone and communnication Charges	8,12,381	2,50,862
7 Printing and Stationary	1,48,077	1,71,129
8 Travelling and Conveyance Expenses	54,086	37,913
9 Subscription Expenses	1,77,000	1,53,282
10 Auditors Remuneration	70,800	70,800
11 Professional Charges	5,71,042	81,140
12 General Expenses	1,62,694	1,07,659
13 Bank Charges	11,556	8,031
14 Books and Periodicals	695	490
15 Website Expenses	-	27,140
16 Training of Sraff	47,687	-
17 Advetisement and Publicity	-	8,400
Sub-total	45,18,427	38,36,773
Less: Expenditure Debited to SERB Abdul KalamTIN Fellowship Scheme	1,00,000	1,00,000
Less: Expenditure Debited to AICTE Schemes	-	-
Total	**44,18,427**	**37,36,773**

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INDIAN NATIONAL ACADEMY OF ENGINEERING, NEW DELHI
SCHEDULES FORMING PART OF INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2022

SCHEDULE 21-A -ENGINEERING PROGRAMMES AND ACTIVITIES	Current Year 2021-22		Previous Year 2020-21	
	Details	Total	Details	Total
Expenditure On				
INAE Seminars/Conferences/Symposivum/Workshops				
Conferences :-		5,46,240		-
INAE Youth Conclave	4,73,080		-	
INAE Foundation Day - Aazadi ka Amrit Mahotsav	73,160			
Engineers Conclave	-		-	
Symposium:-		4,77,610		
Innovation in Manufecturing Practices (IMP)	2,14,275			
National Frontiers of Engineering	2,63,335		-	
Seminars :-		50,000		72,710
INAE Webinar Series	-		72,710	
Seminar on Ethics in Higher Education - Bangalore Chapter	50,000		-	
Workshops/Events:-		3,70,743		8,899
Round Table on Role of Hydrozen in India's Energy Stratagy by Pune Chapter	33,777		-	
Workshop on Smart Cities in Karnataka- Bangalore Chapter	30,450		-	
INAE Workshop Disposal of Laboratory Waste Management, Pune Chapter	1,83,057		-	
INAE- Local Chapter Mumbai	-		1,119	
INAE- Local Chapter Bangalore	-		7,780	
INAE- Local Chapter Delhi	3,835		-	
INAE- Local Chapter Kanpur- 100 Second Vedio Competition	51,000		-	
Online Workshop- Tech Transformation of Indian Agriculture-Bangalore Chapter	68,624		-	
INAE Schemes		19,40,679		11,19,925
Distinguished Techonologists / Professors	6,00,000		6,00,000	
INAE Chair Professorships	-		3,98,950	
Mentoring of Engineering Teachers	3,55,204		60,000	
Mentoring of Engineering Students	2,56,695		60,975	
Frugal Innovation Nurturing Programme- FINP	7,28,780		-	
Research Studies / Projects		27,25,051		21,50,791
Expert Group By Prof. DN Singh on Industrial By Product for Sustainable Infrstructure Development	5,95,200		2,56,800	
Expert Group By Prof. Jayanta Bhattacharya on IRRI of Automationon Mineral Sector	-		93,991	
Expert Group By Prof.Lalit Kumar	1,25,340			
INAE Satish Dhawn Chair of Engineering Eminence	18,00,000		18,00,000	
Landmark Compendiums on Aazadi ka Amrit Mahotsav	2,04,511		-	
INAE Awards		49,65,000		46,10,000
Life Time Contribution Award	10,00,000		10,00,000	
Young Engineer Award	15,00,000		15,00,000	
Young Enterprenure Award	8,00,000		4,00,000	
Women Engineer Award	6,00,000		6,00,000	
Innovative Student Projects Awards	4,15,000		4,60,000	
Outstanding Teachers award	2,50,000		2,50,000	
Professor Jai Krishna Memorial Award	2,00,000		2,00,000	
Professor SN Mitra Memorial Award	2,00,000		2,00,000	
Academia- Industry Interaction Aicte-INAE Schemes		28,91,430		41,49,211
AICTE-INAE Distinguished Professorship Scheme	27,05,653		19,56,073	
AICTE- INAE Teaches Research Fellowship Scheme	-		18,11,500	
AICTE- INAE Travel Grant Scheme	1,85,777		3,81,638	
INAE Forums		-		11,987
Forum on Technology Foresight and Management	-		11,987	
Academy Meetings		4,61,963		80,621
Annual Convention		14,62,739		15,76,331
International Affairs		9,71,318		-
INAE Publications		72,870		3,49,598
Financial Assistance for Engineering activities		-		-
SERB-INAE Abdul Kalam Technology Innovation National Fellowship		649,25,167		418,73,909
INAE Digital Platform		24,57,638		9,62,355
Total		**843,18,448**		**569,66,337**

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INDIAN NATIONAL ACADEMY OF ENGINEERING, NEW DELHI

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 31ST MARCH, 2022

SCHEDULE 22 - EXPENDITURE ON GRANTS, SUBSIDIES ETC.	Current Year 2021-22	Previous Year 2020-21
a) Grants given to institutions/ Organisations	-	-
b) Subsidies given to Institution/ Organisations	-	-
Total	Nil	Nil

Note- Name of the Entities, their Activities along with the amount of Grants/ Subsidies to be disclosed

SCHEDULE 23 - INTEREST	Current Year 2021-22	Previous Year 2020-21
a) On Fixed Loans	-	-
b) On Other Loans (including Bank Charges)	-	-
c) Interest accrued on DST Grants- added in unspent DST Grant	29,085	1,82,583
d) Interest accrued on SERB Grant for Abdul Kalam TIN Fellowship-added in unspent SERB Grant	28,833	2,34,904
e) Interest accrued on AICTE Grant for DVP Scheme-added in unspent AICTE-DVP Grant	83,168	1,89,957
f) Interest accrued on AICTE Grant for TG Scheme-added in unspent AICTE-TG Grant	36,214	40,338
Total	1,77,300	6,47,782

P.K. GAUR & ASSOCIATES Chartered Accountants NEW DELHI

(Bhuwan Adhlakha)
Manager (F&A)

INDIAN NATIONAL ACADEMY OF ENGINEERING

SCHEDULE- 24

ACCOUNTING POLICIES

1. **Basis of Accounting**
These accounts are prepared on the basis of historical cost convention and on the accrual method of accounting.

2. **Grant-in-aid**
Grant received from the Department of Science & Technology and others are accounted to the extent utilized and unspent grant has been shown under current liabilities. Grants relating to fixed assets have been shown under Income and Expenditure Account and its utilization has been transferred to fixed assets under section 11(1) of the Income Tax Act, 1961.

3. **Fixed Assets**
Fixed Assets are stated at cost of acquisition including inward freight, duties and taxes and direct expenses related to acquisition.

4. **Depreciation on Furniture and Office Equipments**
Fixed Assets are depreciated on written down value method of depreciation as per following rate prescribed in Income Tax Rules

Building	- 10%	Office Furniture	- 10%
Office Equipments	- 15%	Computers	- 40%

However, no depreciation has been provided on assets purchased from 01.04.2017 and applied u/s 11(1) of The Income Tax Act, 1961 and in fixed assets schedule it has been shown as utilization under section 11 (1) of Income Tax Act 1961.

5. **Interest on Investments**
Interest is earned on two types of Investments, one against Corpus and General Funds and the other against Earmarked Funds. The interest earned on all the mentioned funds is included in Income and Expenditure account and thereafter interest related to Corpus and Earmarked Funds is transferred to respective funds.

6. **Gratuity & Leave Encashment**
Provision for Gratuity is made as per the payment of Gratuity Act, 1972 and provision for accumulated leave and encashment is made on the basis of number of days of leave accumulated for employee. Actuarial valuation is not made to ascertain such liability.

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SCHEDULE -25

CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS

1. Contingent Liabilities claims against the entity not acknowledged as debts Rs. Nil (Previous ycar Rs. Nil.)

2. Balance Sheet and Income and Expenditure account have been prepared as per uniform format of accounts for Central Autonomous Bodies prescribed by the committee of expert constituted with the approval of Hon'able Finance Minister.

3. Interest Income of Rs. 29,085/- will be surrendered to DST for the year 2021-22, which has been credited to 'Unspent DST Grant' for further transfer of funds to Consolidated fund of India through 'Bharat Kosh'.

4. Figures in Income and Expenditure Account and Balance Sheet have been given as applicable to INAE as per uniform format except the expenditures on engineering programme and activities shown in Schedule 21-A.

5. During the year ended March 31, 2022 a sum of Rs.4,00,000/- has been received from DST as Grant-in-aid towards capital asset creation and an opening unspent balance of Rs. 5,42,224/- was brought forward. Accordingly, the total available balances including the grant received during the year is of Rs. 9,42,224/-. Out of the said balance, a sum of Rs.4,39,407/- has been utilized towards procurement of Fixed Assets/development of INAE Digital Platform. At the end of March 31, 2022, the unspent balance amount of Rs.5,02,817/- is being carried forwarded to financial year 2022-23 along with interest Rs.8,043/-.

6. The balance of security deposits and advances are subject to confirmation/reconciliation.

7. A) INAE Corpus Fund was created in the financial year 2015-16 as approved in governing council meeting held on December 09, 2015 by transfer of Rs. 3,62,00,000/- from the balance available in the general fund as on April 01, 2015 and surplus Rs. 45,00,000/- of financial 2015-16. Interest on corpus fund investment has also been credited to such fund.

   During the Governing Council meeting held on June 13, 2019 it was informed that the implementation of the Recommendations of the 7th Central Pay Commission for INAE employees applicable from January 01, 2016 is pending due to the fact that the relevant letter from DST has not yet been received till date. The matter is being pursued earnestly by INAE with DST.

   Under the circumstances, the Governing Council considered to pay the interim relief and accordingly, an amount of Rs.1,16,03,895/- has been withdrawn towards payment of Interim Relief as arrears (contingent upon implementation of the Recommendations of 7th Central Pay Commission) from Jan 1, 2016 to May 31, 2019 amounting Rs.90,97,616/- and interim relief as additional monthly recurring expenditure amounting Rs. 25,06,279/- (against the total additional monthly recurring expenditure of Rs. 42,00,170/- after charging off Rs.10,00,000/- as manpower grant from SERB under Abdul Kalam TIN Fellowship and Rs.6,93,891/- as Secretarial Assistance grant from AICTE.)

   Since INAE had applied to Department of Science and Technology (DST) for sanction of Grant and pending release of this grant, the sum of Rs. 1,16,03,895/- had been drawn from INAE Corpus Fund and the same will be recouped on receipt of the above grant from DST.

   B) Subsequently, DST raised an observation for giving interim relief akin to 7th CPC benefits to INAE staff, the interim relief being granted to INAE Staff was stopped w.e.f. July 01, 2020 and pay is being released as per 6th CPC scales. This was ratified by INAE Governing Council

in 136th Meeting held on August 24, 2020 vide item no.12 of minutes. Interim relief for July 01, 2020 onwards, if any, will be accounted for after release of Grant from DST.

8. Investment (others)- Term Deposit aggregating to Rs.9,72,00,000/- with SBI taken out of corpus fund and others have been included in investment (others).

9. Utilization certificates are being received from Research Scholars on term year end basis in place of financial year end basis, in respect of the expenditure of Rs. 6,49,25,167/- on SERB-INAE Abdul Kalam Technology Innovation National Fellowship.

10. During the year the following Grant-in-aid have been received from Science and Engineering Research Board (SERB) towards end of the year for new collaborative initiatives, unspent balances of which have been shown under Schedule-11:
    a. Grant-in-aid towards SERB-INAE Digital Gaming Initiative – Rs. 25.00 Crore
    b. Grant-in-aid towards SERB-INAE Collaborative Activities – Rs. 75.00 Lakhs

11. Figures are rounded off to Rupees.

12. Previous years figures have been re-grouped/aligned, where ever found necessary.

For **P. K. Gaur & Associates**
Chartered Accountants
FRN 005311N

P.K. GAUR & ASSOCIATES Chartered Accountants NEW DELHI

Mayank Gaur
Partner
Membership No. 518183

Place: New Delhi
Date: 23/6/2022

On behalf of the Council:

President 23.6.22

Vice-President.....
(Finance & Establishment)

Deputy Executive Director .....

Manager (F & A).....

INDIAN NATIONAL ACADEMY OF ENGINEERING, NEW DELHI

RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2022

	RECEIPT	Current Year 2021-22	Previous Year 2020-21		PAYMENTS	Current Year 2021-22	Previous Year 2020-21
I.	**Opening Balances**			I.	**Expenses**		
	a) Cash In hand	16,506	18,793		a) Establishment expenses Sh 20 as adjusted	166,68,922	153,29,502
	b) Bank Balances				b) Administration expenses Sh 21 as adjusted	44,34,544	38,33,007
	i) In current accounts	-	-				
	ii) In deposit accounts	957,00,000	845,00,000				
	iii) savings Accounts	451,66,766	311,80,823				
II.	**Grants Received**			II.	**Payments made against funds for various projects**		
	a) From Government of India				Engineering Programmes & Activities Sh. 21-A as adjusted	839,05,401	594,08,383
	Revenue	301,00,000	403,00,000				
	Capital	4,00,000	3,00,000				
	b) From State Government	-	-	III	**Investments and deposits made**		
	c) From other sources (details)				a) Out of earmarked/Endowment funds	-	-
	Grant from Other Govt. Agencies	3075,00,000	522,68,832		b) Out of Own funds (Investments- Other)	-	-
III.	**Income on Investments from**			IV	**Expenditure on Fixed assets & Capital Work-in-Progress**		
	a) Earmarked/ Endow funds	-	-		a) Purchase of Fixed Assets	4,39,407	3,73,972
	b) Own Funds (Other investment)	-	-		b) expenditure on Capital Work-in-progress	(2,15,055)	2,15,055
IV.	**Interest Received**						
	a) On Bank deposits	41,68,932	125,97,255				
	b) Loans, Advances etc.	-	-	V	**Refund of surplus money/Loans**		
					a) To the Government of India	-	24,42,500
V.	**Other Income**				b) To the State Government	-	-
	Voluntary contibution/Sponsorship etc.	7,00,000	40,000		c) To other providers or funds	17,08,250	29,993
	Foreign contibution	74,000	72,106				16,53,858
	Registration fees	-	-	VI	**Finance Charges (Interest)**		
	Royalty on Publications	3,98,357	82,878		Interest remited to DST through Bharat Kosh	1,82,560	1,33,051
VI.	**Amount Borrowed**	-	-	VII	**Other Payments (Specify)**		
					TDS on incomes	4,81,653	3,95,774
VII.	**Any other receipts**			VIII	**Closing Balances**		
	Refund from INAE Mumbai Local chapter	1,26,785	-		a) Cash in hand	29,447	16,506
	Refund from INAE Pune Local chapter	1,51,683	-		**b) Bank Balances**		
	Refund of Income tax-TDS	6,31,169	8,06,811		i) In current accounts		
	Refund from INAE Delhi Local chapter	21,165	-		ii) In deposit accounts	972,00,000	957,00,000
	TDS on Accrued interest	4,02,583	2,42,755		iii) Savings accounts	2836,67,831	451,66,766
	Refund from IARC, Hyderabad- Abdul Kalam Scheme	13,87,363	-				
	Refund from IISc Bangalore- Abdul Kalam Scheme	1,18,029	-				
	Refund from VNIT, Nagpur- Abdul Kalam Scheme	12,36,631	-				
	Refund from INAE Bhubaneswar Local chapter	14,162	-				
	Received form IIT-Ihub Foundation for Assets at Vishwakarma B	1,46,450	-				
	Refund from IIT Patna- Abdul Kalam Scheme	-	17,33,333				
	Refund of unspent balance IIT Delhi Youth Conclave 2019	-	3,70,050				
	Refund from INAE Kolkata Local chapter	28,347	1,80,411				
	Refund of unspent balance Lalitha K- ISRO	-	4,304				
	Misc. Receipts	14,032	16				
	Total	**4885,02,960**	**2246,98,367**		**Total**	**4885,02,960**	**2246,98,367**

P.K. GAUR & ASSOCIATES Chartered Accountants NEW DELHI

(Bhuwan Adhlakha)
Manager (F&A)

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(From August 2021 onwards)

Indian National Academy of Engineering