ASME SETTING THE STANDARD | IMECE INDIA 2025

MEEd INDIA
SYMPOSIUM 2025
(IMECE INDIA 2025)

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EXECUTIVE SUMMARY

The Future Is Here – Engineering Education Is Gearing Up To New Challenges

As India races ahead with a sense of confidence and purpose towards the goal of becoming a self-reliant nation and a superpower that contributes to the economic growth of developing countries, the focus will be on the role of the academia in providing trained and skilled workforce and the industry hiring the engineers to run their manufacturing facilities with minimum training during the intake. The educational institutions should also become incubation centres to produce entrepreneurs who will augment the manufacturing capacity in the country. To achieve this lofty goal, the academia should urgently initiate reforms in curriculum. The new forward-looking curriculum should address two major concerns. One, improve employability skills of passing out graduates so that they can be employed by the industry. Two, update the curriculum to incorporate new and emerging technologies such as Sensors, Communications, AI and ML to cater to the demands of Industry 4.0 which involves digital transformation of industries and includes a bouquet of technologies such as IoT and IoT Analytics for industries, automation and robotics, additive manufacturing, and use of AI-ML technologies for product design and optimisation, predictive to prescriptive maintenance, and simulation.

Secondly, to implement the new curriculum the pedagogy needs to change from shifting emphasis from theoretical teaching and rote learning to increasing the practical, hands-on skills component to achieve the perfect balance between theory and practical skills. For the delivery of practical skills and project-based, multidisciplinary learning, the academia need to reach out to the industry for problem statements, internships, industry practitioners as professors of practice or invited lectures and webinars, and helping in setting up infrastructure such as labs and offer scholarships.

The ASME Engineering Education Symposium (MEEd) 2025, held in Hyderabad as a part of IMECE India 2025, comprised six panels and one invited talks, which yielded a number of insights and practical recommendations and action points.

Playbook for Transforming Engineering Education

Some of the important insights and recommendations are:

- Curricular reforms should be expedited and updated periodically.
- Increasing the practical skills component to strike a balance between theory and practicals and knowledge about fundamentals of engineering should seamlessly lead to practical, hands-on skills training.
- Internships and project-based learning should start early - from the first or second semester. Industry practitioners should be involved in the process - from design of projects to evaluation. Hybrid and remote systems should be used so that industry practitioners can engage with the process in a regular and meaningful manner.
- Internships should be spread across semesters and wherever possible faculty should participate in internships along with students. It helps in faculty development and faculty get connected with industry and get exposure to practical industry processes, practices and methods of work. This knowledge will improve in design and delivery of courses.
- A multidisciplinary approach should be woven into engineering courses at appropriate stages.
- New and emerging technologies should be incorporated in the curriculum in a phased manner - starting with workshops, master classes, boot camps and other formats suitable for a particular subject or technology.
- The regulatory authorities such as UGC and AICTE are cognizant of the need to simplify the process for approval of new components and courses so that regular updating and improving the curriculum can be done quickly. Colleges and universities should be further empowered to make periodic changes.
- Besides engineering theory and fundamentals and practical skills, the curriculum should have “soft skills” which are critical to work efficiently in the industry. These skills include critical thinking and problem-solving, behavioural skills relating to communication, adaptability and emotional intelligence and performance and implementation related skills such as collaboration, coordination, teamwork and leadership. These skills should be given due importance otherwise they will not be taken seriously.
- All engineering courses should have a component on sustainability and green engineering. The component should be multidisciplinary encompassing not only the engineering aspect but also relevant humanities aspects such as environmental science/engineering, and even economics, law and public policy so that they become truly multifaceted “domain experts”.
- Though the All-India Council for Technical Education (AICTE) has developed and updated model curricula for various engineering courses, they draw the broad contours of the programme, and it is left to individual institutions to use these flexible frameworks for their individual institutions to work out the nitty-gritty details at a granular level.
- Educational and industry leaders need to work in tandem to align their curriculum and business strategy respectively to the broad goals of national initiatives like Make in India, Start-Up India, Energy Policy and the National Action Plan on Climate Change (NAPCC) to align with the carbon neutral journey goals of India.

INTRODUCTION

There was a buzz of excitement, innovation and new ideas in the air when some of the biggest and most influential names in the industry and academia converged at the ASME Engineering Education Symposium (MEEd) 2025 in Hyderabad as a part of IMECE India 2025. The ambitious but achievable goal was to come up with a clear roadmap, a plan to take ideas from classroom to labs, and from drawing boards to design labs to factory floors. The dream goal was to revive the magic of core engineering by absorbing new age digital and intelligent technologies and make it attractive to the coming generations of students.

Organised by the American Society of Mechanical Engineers (ASME) in Hyderabad during September 10-13, 2025, the International Mechanical Engineering Congress and Exposition (IMECE) India, the Symposium was the flagship event where thought leaders from academia, industry and government came together to discuss and deliberate about ways and means of transforming mechanical engineering education for Industry 4.0 and play a catalytic role in propelling India towards self-reliance make it truly Atmanirbhar (self-reliant).

The MEEd symposium, which was a culmination of the past six MEEd events held in different cities, was a premier platform for stakeholders to brainstorm ideas and take it forward through meaningful connections that pave way for strategic and sustainable collaborations and partnerships to transform engineering education by fostering academia-industry partnerships.

ABOUT ASME & MEEd

A professional organization focused on technical, educational, and research issues of the engineering and technology community, the American Society of Mechanical Engineers (ASME) promotes “the art, science, and practice of mechanical and multidisciplinary engineering and allied sciences to our diverse communities throughout the world”. It also organizes numerous technical conferences worldwide, besides developing and delivering professional development courses. ASME is also a leading developer of codes, standards, and certification programs in the field of engineering. (https://www.asme.org/about-asme)

ASME Mechanical Engineering Education (MEEd) is a premier conference for leaders in mechanical engineering and mechanical engineering technology education.

MEEd endeavours to address the challenges impacting the present and future trajectory of engineering education.

Powered by ASME, MEEd strives to be a platform for discussion about education policy, implementation and its impact within mechanical engineering education.

The key components of MEEd are:

- Sustained engagement with engineering educational institutions regarding curricular innovation
- Continued collaboration with industry to incorporate socially responsible, ethical and sustainable practices in engineering.

Under education, ASME conducts events such as e-fests and EFx in which thousands of engineering students participate. Under careers, ASME has two major fellowships - namely, Engineering for Change (E4C) Research Fellows and Graduate Teaching Fellows.

ABOUT THE SYMPOSIUM

MEEd India Symposium offers a vital platform to explore emerging trends and challenges in engineering in order to ensure engineering curriculum stays aligned with industry demands.

Participants will engage in valuable networking with peers from institutions across the country, fostering connections that can lead to strategic partnerships and collaborations and exchange of insights on modernising programs, recruiting talent, and addressing issues like faculty retention and mental health.

It’s an essential opportunity for advancing academic excellence and gaining practical, peer-led solutions to enhance student engagement and strengthen industry-academic partnerships.

PROGRAMME OVERVIEW

To explore emerging trends and challenges in engineering, MEEd India Symposium focused on innovative, pragmatic and concrete action points to ensure engineering curriculum remains aligned with the changing industry requirements. There were six Panel Discussions and a thought-provoking Invited talk by an expert.

The themes of panel discussions were as follows:

- **Panel 1 -** Industry-Oriented Curriculum Reforms
- **Panel 2 -** AI and Machine Learning
- **Panel 3 -** Inter-disciplinary and Project-Based Learning
- **Panel 4 -** Innovation and Product Development Start-ups
- **Panel 5 -** Sustainability and Green Engineering
- **Panel 6 -** Make in India

Invited Talk by Dr. Yogi Goswami, Distinguished Professor & Director, Clean Energy Research Center USF. Editor-in-Chief, Solar Compass, Journal of ISA

INAUGURATION SESSION

Setting the ball rolling, **Dr. Rajul K Gajjar, Vice-Chancellor, Gujarat Technological University,** highlighted the fact that engineering education needs to evolve around more experiential and hands-on learning with industry playing a major role in it. The changes should reckon with the emergence of Artificial Intelligence and Machine Learning in different domains. At the same time core engineering should gear up to address the challenges posed by climate change and sustainability. The various themes around which the experts on the various panels will be speaking, have been designed to bring in the perspectives from all key stakeholders.

Dr. B Gurumoorthy, Professor, IISc, Bangalore,

Elaborated the prevailing crisis in engineering education and how core engineering has not evolved with the times and incorporated the required knowledge inputs and components in the curriculum. Placing the engineering education's role in the swiftly changing technology landscape, he exhorted the academia to factor in industry requirement and be open-minded and flexible to use new tools for teaching and evaluation. He outlined the two broad themes of the symposium, namely, highlighting the role of what is termed core engineering in the emerging technologies and sustainable development, and how the digital and data technologies can be used to both teach and evaluate engineers at scale.

He concluded by stressing the need to correct distortions in perception that hi-tech is digital only. Digital technology is the cornerstone of modern hi-tech, which includes other disciplines of engineering. He argued for a broader definition that encompasses advanced technologies and practices emerging from diverse scientific, engineering and technological fields.

Ushakiran Malishetty, Program Manager, AFI,

Presented an overview of MEEd in India and how the ASME MEEd Summit was launched in 1989 in the US to be the world's foremost conference that takes an in-depth look at the dynamic landscape of mechanical engineering education.

ASME India hosted its inaugural MEEd Summit in 2022. Since then, ASME has successfully organized six MEEd Summits, attracting more than 700 participants, including engineering faculty, deans, department heads, and students.

He recalled how as an engineering student he was deprived of the benefits of industry-academia interaction. The new generation of students have begun to experience the fruits of MEEd India initiatives which have fostered a dynamic exchange of knowledge and ideas between faculty and students on the one hand and industry practitioners on the other, contributing to the growth of engineering education.

BRIDGE THE GAP BETWEEN ACADEMIA AND INDUSTRY

PANEL - 1

INDUSTRY ORIENTED CURRICULUM REFORMS

There has been a long-felt need for curriculum reforms in higher education, including engineering education. **The National Education Policy 2020 too addresses the issue and advocates a new approach involving emphasis on multidisciplinary orientation and skill-based approach.** The All India Council for Technical Education too has evolved a revised model curriculum for mechanical engineering which addresses issues relating to employability and employment opportunities through skilling of future-ready engineers. In this context, the panel discussion explored the topic, reviewed the progress and made a few pragmatic recommendations to the industry and education leaders.

The panel was chaired and moderated by **Vipin Sondhi, Chairman,** National Board for Quality Promotion (NBQP). Emphasising the urgency for faster and frequent cycles of curriculum reforms to keep pace with fast changing technologies. **Engineering curriculum should not only incorporate emerging technologies but also "soft skills" such as critical thinking and problem-solving,** behavioural skills relating to communication, adaptability and emotional intelligence and performance and implementation related skills such as collaboration, coordination, teamwork and leadership. These skills are critical to navigating complex challenges in industry workspaces.

When it comes to pedagogy, he said due importance should be given to project-based learning and modular flexible learning. Infusing practical skills training would not be possible without industry-academia co-creation. In order to ensure effective delivery of curriculum, faculty development should be encouraged.

Academia-Industry collaboration has been a daunting issue and now there are tested models which could be replicated. The first panellist **Dr Shankar Venugopal, Vice President,** Mahindra & Mahindra, presented two very important use cases that have been tested and validated for their effectiveness. The first one was the creation of micro sabbaticals for faculty persons. These are typically for 4 to 6 weeks during which they get an immersive experience to understand how the industry works so that they can use it in their teaching. The second use case was offering 2-month internships across four years and not just the fourth year. The students need to be accompanied by their faculty persons. There's faculty supervision and oversight as students learn through working on real world problems.

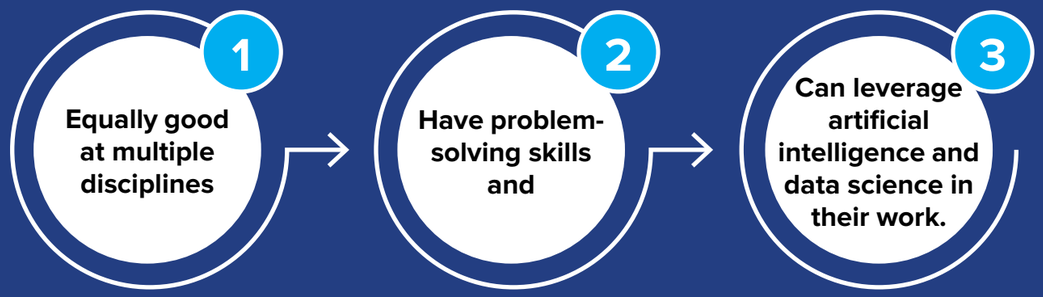
The nagging issue of engineering education becoming "boring" and students who join engineering programmes with huge expectations, begin to lose interest due to the pedagogy. **Pavan Ponnaganti, CEO,** Playto Labs, Bangalore, lamented how an exciting field like mechanical engineering has been turned into a boring subject to learn. There's a need to infuse new energy and joy into learning through creative and innovative teaching methods involving playing and games, which trigger creativity and innovation.

Another major problem is the lack of a real world or industrial context to teaching that happens in engineering educational institutions. Speaking from his own experience which prompted him to start a company to impart training in skills of the future, but through playing, he recalled how joining the Aeronautical Club in his college was a gamechanger for him. His main point was to allow freedom to learn creatively and give them space to experiment. Faculty should play a critical role in motivating students.

Mechanical engineering should not be restricted to traditional boundaries and there is a need to expand its scope and new technologies should be incorporated and embedded into core engineering. **Febin MF, Head, L&T Edutech,** students should be trained to be thinking professionals who collaborate to find solutions and solve problems. She said that her company has developed a curriculum which could be used by universities in a way that is suitable to them. Regarding the importance of catching them young, she said that stakeholders should reach out to youngsters while they are in class 11 or 12 when they are in an impressionable age so that one could kindle their interest in science and engineering and instil a sense of purpose and passion. Once they choose engineering and join an engineering course, active engagement by industry should begin from the first year itself. A multidisciplinary approach is critical to work successfully in the knowledge-driven industry.

Key points from Q&A Discussion

When asked to name three non-negotiable skills, **Dr Shankar said** that universities need to train **"mobility engineers"** (professionals with expertise in design, development and optimisation of technology-driven transport solutions) who are



There is a need for cross-disciplinary bridge courses. Universities should consider offering the above knowledge and skills as a "finishing course", a short course designed to enhance the student's skills especially with regard to preparing for employment.

Answering a question on capstone projects, Prof Gurumoorthy said some institutions have capstone projects but they are not being done properly for optimum results. In some institutions, industry sponsors the capstone project. To make them effective, both faculty persons and industry practitioners should jointly supervise the execution of the project.

Ms. Febin was of the view that one of the major challenges in curricular reforms is striking the balance between theory, especially the fundamentals, and practical skills while blending academic teaching and industry training. Theory and fundamental concepts enable engineers to understand the science and technology behind applications and machines. It is necessary for designing products, for modifying, customising products and finally for troubleshooting.

Explaining the work done by her division, she said taking faculty and students to the project sites or shop floors yielded substantial results.

Chirala Pandu Ranga Rao, Sr. Vice President-Technical Operations and Strategic initiatives,

Altair, said students should do 6-month long projects in the industry in order to develop industry-relevant skillset. Being sent to work in incubation centres will make students think like innovators. He flagged some constraints, including confidentiality issues and time and resource constraints.

There was an interesting discussion on a question by **Dr Rajul** regarding how to scale industry-academia partnerships through internships and projects. The panelists gave a number of practical solutions. Big companies should set up regional centres to cater to engineering colleges and universities located in and around Tier-2 cities. Building a pipeline of new ideas, projects and technologies can go a long way in deepening and broadening existing partnerships.

Another suggestion was to set up co-curricular clubs where there's space for experimentation, for creativity and activities can be designed with specific learning outcomes. These clubs can have a proper calendar of activities. What cannot be easily incorporated in the existing curriculum framework could be done through the clubs which by nature are quite flexible.

Dr T Kishen Kumar Reddy, Vice Chancellor,

Jawaharlal Nehru Technological University Hyderabad, expressed concern about the decline in the interest in engineering courses in general and core engineering courses in particular. Panelists said that there is a renewed interest in core engineering courses and the early signs are there and some of it is coming from the start-up ecosystem. They expressed optimism that it will get better in the coming 5 years.

To sum up, there is a wider acceptance of the need to rejig and re-orient engineering curricula with regards to increasing the practical skills component and adoption of new and emerging technologies, digital tools on the one hand, and on the other, the soft skills necessary for working in the industry.

Besides adhering to standard systems for course delivery, newer forms should be introduced in design, delivery and evaluation through options like workshops, boot camps, master classes by experts and industry practitioners, curricular and co-curricular projects, hackathons, etc. Modular learning options such as micro-credentials and hybrid formats will be helpful.

Industry practitioners should be involved in curriculum design and delivery and minimising bureaucratic red tape can expedite and simplify the process of their involvement and contribution. They should be involved in practice-based learning simulating real time industry problem solving via assigning industry projects, industry work practices, immersion and understanding and use of standards that facilitate Industry trade practices.

The faculty should dovetail their teaching with industry-oriented projects and assignments. Regular faculty development interventions will help in making curricular reforms and implementation effective.

FAST-TRACKING THE INTEGRATION

PANEL - 2

RAJKUMAR SADANANDAM | RAMESHA BS | DR. ABHISHEK SINGH | DR. ASIM TIWARI | DR. ANSHUMAN AWASTHI

AI AND MACHINE LEARNING

With the development and popularisation of Artificial Intelligence and Machine Learning technologies and tools and the potential for their application in mechanical engineering, universities have been discussing ways and means of integrating them into curriculum. AI and ML technologies can play a major role in three areas, namely,

- Design and optimization of products to reduce the need for physical prototypes,
- Predictive maintenance to forecast possibilities of glitches and failures, and
- Simulation that enables advanced automation.

In this context, the panel discussed ways and means of integrating AI and ML in curriculum and the need for infrastructure like advanced labs.

The Chair and Moderator, **Dr. Anshuman Awasthi, Senior Vice-President,** Mercedes Benz, presented an overview and initiated the discussion. **Dr. Asim Tewari, Professor-ME,** IIT Bombay, said since 2010 there has been no turning back and technologies are becoming smarter and intelligent and it is difficult to predict the shape of things to come even in the next five years. Only thing one can be sure about is that the impact will be profound.

Dr. Abhishek Singh, Professor, MRC, IISC, said universities should introduce courses in AI and ML which have the required depth. Mr. B S Ramesha, Head Initiative, Altair, shared the example of application of AI wherein a student used AI in the area of traffic control and regulation. He explained how AI-ML tools could be used in the vehicle design for

the student-centric event, BAJA SAEINDIA. Another application another student worked on relates to making available to users EV critical information relating to battery charging and how long it will last. It is a mandatory requirement for any professional involved in developing “smart” products to be well-versed with AI-ML technologies indicating the importance of incorporating AI-ML in engineering education. The initiative proposes the formation of dedicated Student Simulation Groups aimed at fostering industry-oriented skill development among engineering students. These groups, like SAE or ASME student chapters, will focus on developing key technical competencies relevant to domains such as CAD, CAM, CAE, and PLM through open learning platforms and collaborative projects. Each group will be guided by a faculty mentor and will dedicate at least two hours per day for a minimum of three days each week to structured learning and hands-on practice. Members will document their learning outcomes systematically to create valuable reference material for future batches. The groups will also organize student competitions to test and showcase their technical skills, conduct surveys on emerging job opportunities, and interact with industry recruiters to align their training with market requirements. Faculty members and the institution will actively monitor and support these activities to ensure sustainable, skill-based educational growth.

Mr. Rajkumar Sadanandam, Global Head, Smart Controlled Products, TCS, said AI will come in different forms and shapes. When it comes to mechanical engineering, or products and equipment, AI needs to figure out the language suitable for the domain. It is an emerging area that needs attention. Secondly, AI needs to be merged or integrated with physical things like robots. For instance, a robot’s hand is one of the most complex mechanisms and when it is integrated with AI, it will be magical and that is going to happen. Lastly, all along humans have used machines to accelerate production and in future AI will be used to accelerate innovation.

Dr. Awasthi said from the education point of view students should be imparted with knowledge and skills to create new patterns that are essential for AI systems to grow and mature. Dr Tewari reiterated the importance of engineering fundamentals which are not going to change and that should get due importance in the curriculum and should be taught to students.

He listed three aspects of AI which needs to be considered which comes from his experience of teaching AI in IIT Bombay.

1. **The relevance of fundamental mathematical foundation, including linear algebra, calculus, etc. which is important for those developing newer algorithms.**
2. **The inference aspect or how to use and apply AI and it calls for programming and coding skills, which has short shelf life as AI is itself doing coding and taking away jobs.**
3. **The niche area of AI in industry which calls for domain knowledge. A blend of engineering and AI, of data science and domain knowledge holds the key to the future.**

Mr Rajkumar said statistics should be taught at undergraduate level while **Mr Abhishek Singh said** research in use of AI in material sciences is necessary. **Mr Ramesha said** electives can be a good way to allow students to learn AI and other new technologies.

All the panelists were of the unanimous view that AI must figure in every curriculum and it needs to be updated far more frequently as the technology is changing rapidly. However, there was a diversity in opinion regarding the course composition and level of knowledge to be imparted. Likewise, all panelists stressed the need to strike a balance and take calibrated steps.

Lastly, the panelists discussed the impact of AI on humans and the need for an ethical framework, and how humans should retain control over AI and traditional science and research should not be abandoned. The AI should work for humans and not the other way round and this must be ensured at every stage from development to execution.

During the Q&A session, delegates discussed the limitations of the technology and how to factor it in the thinking about and decision-making.

To sum up, both industry and academia are recognising the growing need to integrate AI/ML concepts across core engineering disciplines in order to produce engineers of the future who can work effectively in the continuously evolving technological landscape.

AI and ML can be integrated into curriculum through mini courses, workshops and also by using case studies and exploring real-world applications.

The areas of study could be predictive maintenance, design optimization and simulation and how it is being used in different sectors.

The subjects to be taught should depend on the level of the student and how he or she will use it. For one it could be how to use AI in work, for another how to develop or code for AI. Emphasis should be on practical skills and working with tools such as Python, TensorFlow, and MATLAB.

Industry expertise should be sought for research, in setting up AI labs and giving inputs for capstone projects.

In order to teach new technologies, faculty persons should not be hesitant or feel inhibited to under training to keep pace with advancements.

FROM FRAGMENTATION TO AMALGAMATION

PANEL - 3

CHIRALA PANDU RANGA RAO | DR VINAY RAMANATH | ALEX TAN | DR G SARAVANA KUMAR | DR TIMOTHY A GONSALVES

INTERDISCIPLINARY AND PROJECT-BASED LEARNING (PBL)

Breaking away from rote learning in higher education and integrating theory and practice has been a major challenge faced by educational institutions. Problem-solving and creativity became an important employability skill sought by the industry. Engineers can no longer work in silos and therefore multidisciplinary approach is gaining prominence as every engineer who aspires to work in “smart” factories of the future need to have basic level to working level of knowledge in allied fields like computer science, data analytics, besides the expertise in their respective domains.

Chair and Moderator of the session, **Dr. Timothy A Gonsalves, Professor Emeritus (Hon), IIT Mandi,** said though India produces an impressive number of engineers, many of them lack employability skills. Another aspect is that graduates may have the knowledge of engineering but lack the mindset and are not trained to think like an engineer. Elaborating the point, he said that the mindset involves solving problems faced by the society to the satisfaction of people. And this is not a part of curriculum and taught in most institutions.

Sharing the experience of how IIT Mandi revised the curriculum so that there is a practical component of doing things, getting their hand dirty in working on useful products right from the first year of the course through to the fourth year. It worked quite well for over ten years. **Efforts were then made to replicate this learning by doing pedagogy in other institutions, especially those in Tier-2 colleges, through a project based in IIT Madras Research Park named LEAP which provides IIT Style / Industry-oriented** Product Driven Learning to Engineering Colleges by focused

programs from 1st Year to 4th Year B Tech. All LEAP activities involve building products and learning by doing.

I**n last four years, the LEAP programme has covered about 5000 students.** The outcomes included, developing in about 3-4 months a robotic arm to feed a person who is unable to eat on his/her own, a medicine dispenser, and finally setting up a start-up. In another college, the placement percentage doubled due to the LEAP programme. Anna University in Tamil Nadu and Mysore University have introduced the LEAP course into their curricula. **AICTE has approved a project called Practice which brings in LEAP type of pedagogy into a thousand low-performing engineering colleges.**

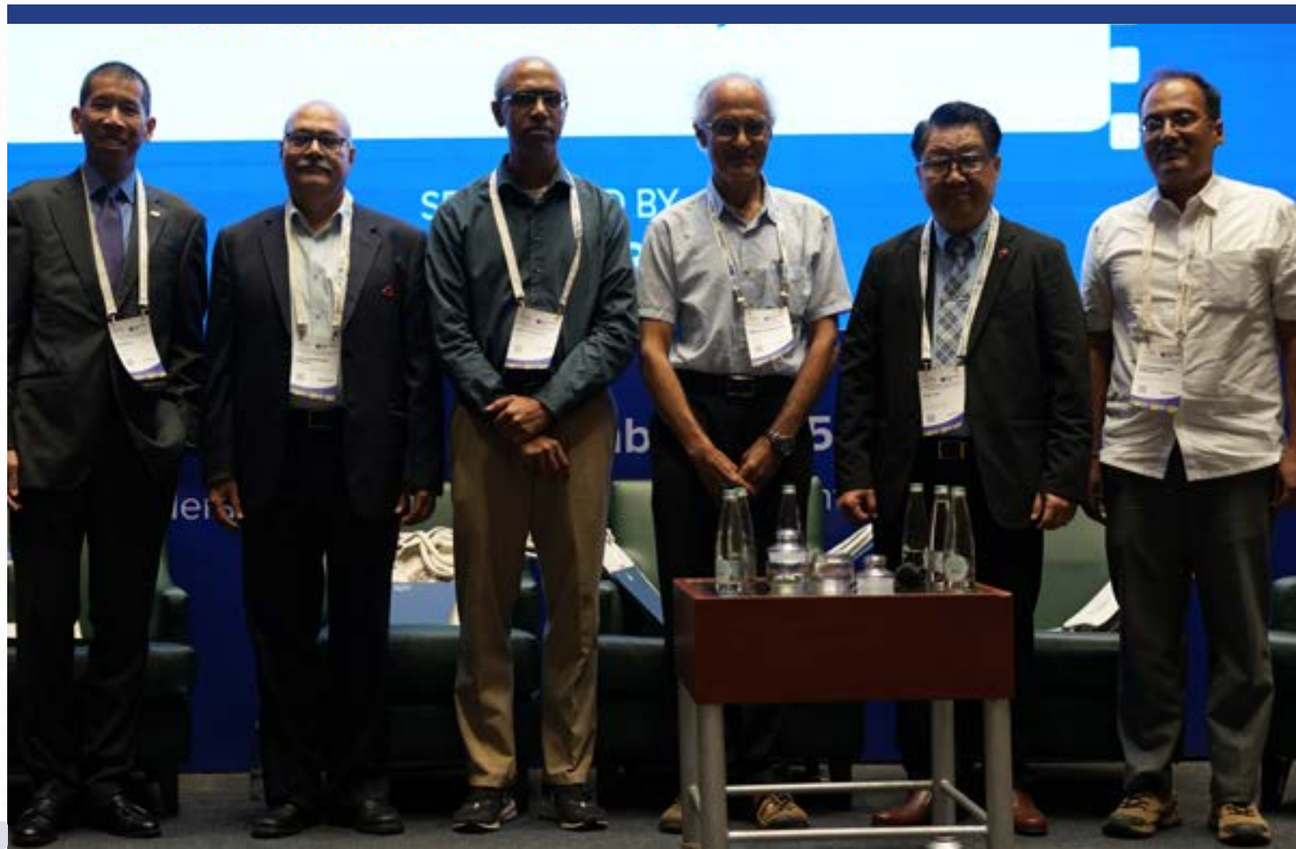
All along engineering courses largely remained within the clearly defined boundaries of their discipline or stream. Thus system integration emerged to fill the gap formed due to isolated work processes. **Dr. Vinay Ramanath, Principal Expert R&D,** S**iemens Technology,** said as a system integrator he works with multiple departments which work in silos for ease of operations. One of the ways in which the industry addresses this issue is by getting entry-level employees or freshers to work in different departments to understand how each one works and that exposure helps gain system level interdisciplinary knowledge and understanding which in turn helps in making them world class engineers. The engineering colleges could give their students some exposure to other related disciplines so that they are able to work engineers and professionals from other disciplines.

There are some courses like automation, mechatronics, robotics need to have a substantial practical component as against traditional theory-based learning. Students find these course interesting and engaging as they get to do things. **Alex Tan, Director, Asia Pacific, ASME, explained how he was involved in an automation training programme in Singapore that helped them gain knowledge in M2M or machine to machine and subsequently Internet of Things (IoT) technologies.** The programme was very successful and emphasised how project-based learning can bring about interdisciplinary learning. As an industry professional working in academia, he said he was aware of the pain points of the industry and got the academia put together a team to provide inputs and solutions to industry problems.

Emergence of new technologies is beginning to make a deep impact on product design which is shifting from a linear or sequential and human-intensive process to data and technology-driven methods. **Mr Chirala Pandu Ranga Rao, Sr. Vice President-Technical Operations and Strategic initiatives,** Altair, too shared the lessons he learned from his own experience. Several years ago, it would take about eight years to develop a new car and 14-16 years to develop a new aircraft as much time goes into designing and testing. Instead of sequential product development, the industry adopted concurrent product development which helped shrink the timeframe and in a much shorter time - it is 8-11 months for developing a new car. This was possible through concurrent development - that is, both design and manufacturing teams worked concurrently in working on the prototype.

Another issue to address was the higher cost arising out of developing the actual physical product as a prototype, for instance. This involved expensive “tooling” which was addressed through technology. Thus, physical product development to dispersed, remote, virtual enabled collaborative product design. Another area where India can be a leader is in developing data-driven design.

Project-based learning and interdisciplinary curriculum is being implemented in some institutions. **Dr G Saravana Kumar, Professor, Dept. of Engineering Design, IIT Madras,** explained how it was being done in IIT Madras through a highly specialised 5-year dual-degree course in with specialisation in Automotive Engineering, Biomedical Design and Robotics that focuses on design and multidisciplinary approach. Based on the success of this experiment in one department is now being replicated in other departments.



An important highlight of the programme is introducing practical projects early on - that is, second semester itself when students have to come up with a project idea, a requirement analysis followed by an idea of form and function of the proposed product. This was done even before they are trained in core engineering so that they can think creatively and appreciate the process of product development.

The projects and followed by internships. **As an integral part of the curriculum, students will have to do an internship in the industry for one full semester in the eighth semester of the 10-semester course.** In terms of evaluation, **80% of the marks are assigned to project assignments, while the remaining is for other assignments involving writing, etc.**

The dilemma regarding specialist versus generalist needs to be dealt with. One way to resolve it is by promoting T-shaped skills or T-shaped professionals. T-shaped professionals possess excellent knowledge of and skills in specific areas and are good at working with others in a collaborative way. They are invaluable in roles that require deep technical skills and the ability to understand, communicate, and collaborate with other domains.

During the Q&A session, pan elists discussed the practical challenges faced by engineering colleges bound by university and AICTE system and its regulations and constraints. Secondly, how to ensure coordination between faculty from different departments. Thirdly, how to evaluate multidisciplinary project-based learning activities. Panelists suggested starting at a smaller scale, may be through smaller initiatives, course components or projects. They can be later scale them up with required permissions and approvals.

Regarding evaluation of project-based learning activities and assignments, wherever industry is involved, industry persons can give feedback that can be converted into marks. Also, team members can do some self-evaluation keeping in mind the contribution of team members. The faculty person in charge can give marks and consolidate everything.

Summing up, some important points and practical action points were made. They include:

- Break silos and promote interdisciplinary learning and project-based learning should be introduced early on - as early as first or second semester.
- Start small - either as a course component or even a workshop or boot camp.
- Start a project that involves one discipline and go on to add complexity that would involve other disciplines
- Get management buy-in and follow it up with some faculty development programme to update the skills of teachers.
- Sabbatical for faculty to upskill and work in the industry.
- Involve Professors of Practice (industry practitioners with experience) in project-based learning activities - from supervision to evaluation. This is more practical with the availability of facilities for virtual and remote interactions.
- Matching expectations of all stakeholders is critical for the success of industry-academia partnership.

CALLING CARD OF THE FUTURE

PANEL - 4

INNOVATION AND PRODUCT DEVELOPMENT START-UPS

Academia should play an important role in promoting innovation and initiating and incubating or setting up of startups. This can be done by generating new ideas and solutions through fundamental research, set up incubation centres that provide expertise and facilities for students who want to be budding entrepreneurs. Of course, the curriculum should enable and nurture entrepreneurial talent. Universities can derive benefit from interaction and collaboration with industry to translate discoveries into marketable products.

India can boast of a healthy and thriving start-up ecosystem consisting of a vast network of entrepreneurs, investors, and support systems. There are many success stories and prominent among them are the some of the well-known unicorns (startups valued at over $1 billion) which have become household names. **Dr PVM Rao, Professor, Department of ME, IIT Delhi,** presented an overview of the start-up scenario in India and government initiatives to promote entrepreneurship among youth. There are success stories in UPI, digital infrastructure, space, etc.

Research and development in the industry and academia is critical for innovation and the growth of product development start-ups. There is a definitive role for educational institutions in this space as higher education institutions are involved not only in teaching (knowledge dissemination) but also in research (knowledge creation). A new addition is knowledge application. The good thing is innovation is moving from co-curricular space to core curriculum.

Extra-curricular and co-curricular clubs have been around in engineering college for a long time now. Gradually they got integrated into the structured programmes to fill the gaps in curriculum. Recognising their potential to trigger and drive innovation and entrepreneurship, the government and academic institutions began to promote them in a big way. Smart India Hackathon is a case in point. **Dr Kavi Arya, Professor, Computer Science & Engineering Dept, IIT Bombay,** drawing up on the experience of e-Yantra, a project sponsored by Ministry of Education through the National Mission on Education through ICT (NMEICT), explained the importance of these initiatives.

The e-Yantra Robotics Competition (eYRC) is a truly inclusive platform that welcomes teams with varied skill levels - from beginners to advanced participants from premier institutes to lesser known tier-2 colleges. **He said knowledge acquisition should be experiential and there is abundant talent in tier-2-3 colleges which needs to be tapped.** Participation in e-yantra has tangible benefits - get placed quickly and at higher pay levels. In a scenario where employment market is going through uncertainty and crisis, participation in innovation can provide an entry point to entrepreneurship for self and even create jobs for others. One of the obstacles to innovation and product development is the bias against building things - as that is considered to be a low-level work typically done by students from ITIs and not IITs. But that wrong mindset is changing of late.

Engineering colleges have limited funding which goes into running the institution. Many institutions are cash-strapped and are unable to spend on critical infrastructure such as specialised labs, new research and innovation initiatives. **Dr Ashok G. Verghese, PRO Chancellor,** Hindustan Institute of Technology & Science, said funding should not be a constraint for fostering innovation. **There are three stakeholders:**

The academia which has the talent pool

The industry which has real-world problems and experience

The government which has the power to frame policies and provide funding

Only when all the above three come together can innovation happen. In an educational institution, while incorporating innovation and product development in its curriculum the emphasis should be on triggering creativity and innovation and not on scale. Frugal innovation can be scaled up later in the next phase.

Since the purpose of engineering is to solve real-world problems, engineers should have an entrepreneurial mindset so that they need not limit themselves to coming up with innovative technological solutions but actually set up companies that use those them. **Dr Surya Kumar S, Professor, ME, IIT Hyderabad,** explained how educational institutions can instil entrepreneurial mindset in students so that they can leverage it both as founders and employees. Since success rate is low in start-up space, those who attempted running start-ups will have valuable employability skills and should be sought by employers.

The Q&A session discussed issues such as product differentiation, exposure of faculty to multidisciplinary culture and frameworks in real-world industry, at what stage should manufacturing or industry start-ups with varying levels of TRL or Technology Readiness Levels collaborate with academia in a circular model, about internship models, joint industry-academia project models.

The YRF or Young Research Fellow programme in IIT Madras in which under-graduate and dual degree students are encouraged to do intensive research and start-ups can collaborate with them.

The key takeaways from the session included the following:

Not only academia even industry often works in silos and the situation is changing to a more integrated and interdisciplinary processes.

Industry-academia collaboration is necessary at every stage of product development - from idea coming out of research and problem statements from industry, and design and development coming from hands-on projects in colleges.

Academia can have innovative models like YRF of IIT Madras wherein students have opportunities in engage in research and work with industry problems.

The regulatory bodies should give greater autonomy to colleges to allow industry-academia collaboration.

The mismatch between timelines of the university and industry need to be addressed when

In teaching and research, priority should be given to practical knowledge and ideas with application potential and value.

To tap the talent in academia, industry should come forward to pro-actively set up infrastructure like labs, offer funding assistance through scholarships, etc.

Lastly, India needs social innovation along with innovation in lifestyle and leisure commerce. Social relevance and impact should be factored in while promoting innovation and product start-ups. Integrating inclusivity and sustainability will make it not only viable but also helps in mobilising funds. A sense of satisfaction of changing lives can drive entrepreneurship.

INVITED TALK BY

Dr. Yogi Goswami, Distinguished Professor & Director, Clean Energy Research Center University of South Florida and Editor-in-Chief, Solar Compass, Journal of International Solar Alliance

Climate change is a fact and it should not denied. There is enough evidence in the form of rising sea levels, occurrence of severe climatic events in increasing frequency, and its impact on public health in the form of heat exhaustion, heat strokes, mental Illness, vector-borne infectious diseases – from mosquitoes & ticks and alterations in soil & ocean micro biomes – profound changes in plants, nutrition and human health, and lastly the emergence of new viruses due to global temperature rise.

The global community needs to come together to find ways to meet the Net Zero Carbon Emissions or NZE to limit the global temperature rise to 1.5oC – and many nations have made commitments to meet the NZE goal by 2050. However, analyses by IEA and IRENA show that with current policy scenarios, we will fall woefully short of achieving both goals.

The academic research can play a big role in inventing new solutions that can help countries achieve the NZE targets.

Dr. Goswami explained in great detail some of the innovations which have their roots in academia. These innovations are:

- Utilizing deep space as the heat sink for radiative cooling
- Development of paints that can reduce heating
- New color changing coating to cool or heat buildings as required
- Touchchronic coating
- The Goswami Cycle (Combined Power & Cooling) which uses low to medium temperature heat to produce simultaneous power and cooling which has applications in industrial processes, in solar power.

THERE'S NO PLANET B YET

PANEL - 5

SUSTAINABILITY AND GREEN ENGINEERING

Given the country's goals and commitments relating to sustainability and green engineering, there is a clear urgency to integrate sustainability principles and green engineering & technology into core engineering curricula to prepare students for emerging clean energy sectors. The need of the hour is to integrate sustainability and green engineering into core engineering courses.

The importance of environmental subjects are well-known have gained prominence as can be seen in engineering courses such as B.Tech and M.Tech programs in Environmental Engineering, which are driven by growing environmental concerns, government's national initiatives and global sustainability goals . Chair and moderator of the session **Dr. GD Yadav, National Science Chair, SERB, Govt. of India** said sustainability requires collaboration across disciplines and a blending of mechanical, chemical, environmental engineering with data science and systems thinking. Sustainability also needs models of industry–academia collaboration (pilot projects, co-developed training, research) to accelerate solutions.

The present curriculum falls short when it comes to knowledge and skills relating to sustainability and green engineering.

Environment is a truly multidisciplinary subject. Besides humanities dimensions of law, public policy, etc, environmental science has been taught in colleges. Engineering is the last mile as it applies scientific and engineering principles to design technological solutions and machines and systems for water and air pollution

control, waste management, sustainable infrastructure, and resource conservation. **Professor S Dasappa, Chair and Professor, Interdisciplinary Centre for Energy Research (ICER)** made a detailed presentation in which he emphasised the fact that mechanical engineers are and should be at the heart of energy transition - not only in designing and improving the hardware that makes clean energy possible but also in optimizing the entire energy ecosystem to be more efficient, reliable, and sustainable.

Mechanical engineers thus play a crucial and multifaceted role in the energy transition — the global shift from fossil fuels to cleaner, more sustainable energy systems. Their skills in thermodynamics, fluid mechanics, materials science, structural design and systems engineering are essential to redesign and optimize energy production, storage, and consumption. These subjects are critical for most renewable energy systems.

Engineers need to be given multidisciplinary training in core engineering, environmental science/engineering, and even economics, law and public policy so that they become truly "domain experts" who play pivotal roles in shaping, managing, and implementing energy strategies that support decarbonization goals.

At a time when mechanical engineering courses are not getting enough students and some colleges are even closing some core engineering courses due to poor response from candidates seeking admission, a holistic and new approach is needed to tackle the issue. The strategy should include curriculum innovation, interdisciplinary approaches, and skill-building.

Dr Yogi Goswami, Distinguished Professor & Director, Clean Energy Research Center USF. Editor-in-Chief, Solar Compass, Journal of ISA, said new innovations in technology, policy and financing will play an important role in achieving the NZE goal. The major focus areas for academia are industrial process energy and renewable energy and should strive to do research to invent clean energy solutions that will address some of the major climate change challenges. Research should translate into technology solutions that improve society.

The focus areas of the new sustainability era are Data centers, Electric Vehicle, Fuel Cell; Aluminium manufacturing and additive manufacturing; Green hydrogen and transport and lastly, water. **Dr Rimzhim Gupta, Senior Applied Scientist (R&D),** Paanduv Applications explained how data computation is a prerequisite for addressing sustainability issues.

Dr Rajul K Gajjar, VC, Gujarat Technological University said already steps are being taken in her university which offers minor courses and **electives on sustainability engineering, especially renewable energy. Sustainability is now a mandated competency and a required graduate attribute across GTU. Over 25+ core modules and 15+ interdisciplinary electives are being offered which engage thousands of students.** GTU also ensures sustainability in terms of energy efficiency, water conservation, waste management and natural resource conservation is factored in the green building and infrastructure built on campus.

To bridge the industry-academia gap, GTU has established GTU Ventures in 2010, which is one of India's largest university innovation ecosystems with regional hubs in Surat, Vadodara, Rajkot, Mehsana, Modasa and Bhuj. It connects academia with industry through incubation, mentoring and startup support.

The university is aligning its courses, faculty and students to broader sustainability goals. All research and other projects should mention the Sustainable Development Goal (SDG), otherwise it will not be approved or funded. If one were to look at the technological solutions it would be clear that it requires multidisciplinary outlook. She spoke about the gaps in the engineering education in the context of sustainability and green engineering and said universities will have to find financial resources and funding for setting up specialised labs which will facilitate practical learning.

Key Takeaways:

Sustainability should be a mandated competency and a required graduate attribute across GTU.

Sustainability requires collaboration across disciplines and a blending of mechanical, chemical, environmental engineering with data science and systems thinking.

Sustainability also needs models of industry–academia collaboration (pilot projects, co-developed training, research) to accelerate solutions.

Role of student-led projects, competitions, and innovation challenges play an important role in shaping sustainable solutions.

Set up centres of sustainability.

Set up specialised next-gen labs and university innovation and research ecosystems. This could facilitate and enable sustainability start-ups.

Enable student-led innovation

Capacity building and up-skilling among faculty and lab staff to teach sustainability and hydrogen technologies should be undertaken.

The need of the hour is to unite research excellence, industrial capability, and supportive policy in the field of sustainability and green engineering.

India's opportunity to lead in sustainable innovation. It should lead with innovation, guided by ethics and anchored in sustainability.

FROM CHIPS TO SHIPS

PANEL - 6

MAKE IN INDIA

Engineers play an important role in nation building and sustainable development. Engineering education has to produce knowledgeable and skilled engineers who will be the driving force behind innovation, technology development and deployment and building infrastructure. Thus, there is a renewed focus on aligning engineering education with the national vision of Aatmanirbhar Bharat by promoting self-reliance and manufacturing excellence.

The panelists - **Dr Pramod Kumar, Professor,** IISc, **Ms. Pamela Tikku,** Vice President & Head - Auto, Group Public Affairs, Mahindra Group, **Dr Agraja Magesh,** Assistant General Manager, LSI-MECH ENGINEERS PVT LTD, said the success of Make in India would depend on prioritising quality and compliance with international standards.

A product of bridging academia and industry, **Dr Agraja** explained how her academic research (PhD) helped find the solution. Engineering education, governmental policy and industries are working together with an emphasis on quality first mindset.

Ms Pamela traced the evolution of Indian industry before and after 1991 economic reforms and gave examples of how the licensing and subsequent regulatory hurdles in the path of the automobile industry. Thanks to advocacy by industry, testing and certification infrastructure was set up in India. That she said was the beginning of the realisation to make Indian industry both self-reliant and globally competitive. The Atmanirbharata for automotive industry began in late 1990s.

Over the years due to various internal and external factors, India is beginning to pursue the goal of self-reliance or Atmanirbhar Bharat 2047.

Dr Pramod Kumar said India should make in India for Indians. First, Indian products should be first sold in India and then make products for the world. Indian industry should comply to standards at every stage – from raw materials to final products – to make world class products.

The serious gaps or bottlenecks for Make in India are:

- Talent or skill of human resources
- Infrastructure
- Government Policy
- Mindset of all stakeholders – from academia to industry to consumers

The panelists deliberated in great detail about skilling and the role of academia and industry in it. The main points were:

- Skilling should be industry-relevant; curriculum should be performance-driven. Academia should produce industry-ready engineers.
- Industry should give academia problems to work on and to do research
- If due to confidentiality, industry cannot share problem statements, there should be a closed loop system to do so.
- Academia should change its mindset to accept what could be perceived as “small” or “simple” problems from the industry.
- Industry-academia interaction should lead to creation of good IPs which are India-centric to start with.

Given the size and diversity of the country, India should be the market for products developed and produced here. There is a perceptible change in customer awareness and knowledge and therefore they will demand quality. Therefore, the quality mindset should be instilled in engineering colleges and the industry should be committed to the pursuit of excellence. Another area of interest would be enhancing skills through skilling competitions and panelists said ASME should take the lead in this regard.

Lastly, Make in India has a longer timeline and therefore would require sustained effort on the part of the academia and the industry. It should not be treated as a short-term project. Time and effort is required to bring about fundamental changes required to implement Make in India and make it a part of the DNA of both academia and the industry.

Summing up the discussion, Chair and moderator, **Dr B Gurumoorthy, Professor,** IISc, said all the panelists have emphasized the importance of 3Ss - Standards and quality for achieving the goals of Make in India, Skills that must be constantly updated and Sustained efforts through setbacks and failures.

The key takeaways included:

- Curriculum should aim to equip students with an array of skills ranging from design and prototyping to product lifecycle management. These skills are critical to drive indigenous innovation and support local manufacturing.
- Strong academia-industry collaboration is encouraged to co-create products, technologies, and startups that address domestic challenges with global opportunities.
- Instead of focusing only on large corporates, educational institutions should turn their attention to MSMEs for mutually-beneficial collaboration and partnership.
- Engineering programs should align with national policies like Make in India, PLI Schemes, and Startup India for identifying problems and project topics. Students should be inculcated with the **“build for India”** mindset.

CONCLUSION AND RECOMMENDATIONS

Engineering education should play its role in nation building. India has ambitions of becoming a superpower, a manufacturing giant, the factory of the world, an innovation powerhouse that will give impetus to entrepreneurship and the growing start-up ecosystem. These dreams cannot be realised without tackling the challenges and gaps in engineering curriculum and pedagogy is one of them.

Engineering in general and mechanical engineering in particular, is being subjected changes by new technologies that drive Industry 4.0. Engineers can no longer work in silos as their jobs require interaction and working with others. Therefore, engineering education should be multidisciplinary. Moreover, there is a greater need for team work and collaboration skills, which again need to be taught in a structured way, especially through projects and internships.

The deliberations and discussions point to the need for the following:

1. Outcome Metrics & Targets

Including measurable goals (e.g., number of institutions adopting PBL, faculty immersions, student innovation outcomes, industry co-developed credits) will help track the impact of MEEd initiatives going forward. (See Annexure)

2. Centre of Excellence (CoE) Model for Industry-Academia Collaboration

Evolving a short framework which aligns with **the national skilling, R&D, and startup agenda, showing how HEIs can partner with industry to set up COEs around:**

Digital engineering & simulation | **Green energy & sustainability** | **Mobility & manufacturing**

The two-day symposium discussed the issues threadbare and have come up with some practical, doable action points.

Some of the important insights and recommendations are:

- Curricular reforms should be expedited and updated periodically.
- Increasing the practical skills component to strike a balance between theory and practicals and knowledge about fundamentals of engineering should seamlessly lead to practical, hands-on skills training.
- Internships and project-based learning should start early - from the first or second semester. Industry practitioners should be involved in the process - from design of projects to evaluation. Hybrid and remote systems should be used so that industry practitioners can engage with the process in a regular and meaningful manner.
- Internships should be spread across semesters and wherever possible faculty should participate in internships along with students. It helps in faculty development and faculty get connected with industry and get exposure to practical industry processes, practices and methods of work. This knowledge will improve in design and delivery of courses.
- A multidisciplinary approach should be woven into engineering courses at appropriate stages.
- New and emerging technologies should be incorporated in the curriculum in a phased manner - starting with workshops, master classes, boot camps and other formats suitable for a particular subject or technology.
- **The regulatory authorities such as UGC and AICTE** are cognizant of the need to simplify the process for approval of new components so that regular updating and improving the curriculum can be done quickly. Colleges and universities should be further empowered to make periodic changes.
- Besides engineering theory and fundamentals and practical skills, the curriculum should have “soft skills” which are critical to work efficiently in the industry. These skills include critical thinking and problem-solving, behavioural skills relating to communication, adaptability and emotional intelligence and performance and implementation related skills such as collaboration, coordination, team work and leadership. These skills should be given due importance otherwise they will not be taken seriously.
- All engineering courses should have a component on sustainability and green engineering. The component should be multidisciplinary encompassing only the engineering aspect but also relevant humanities aspects such as environmental science/engineering, and even economics, law and public policy so that they become truly multifaceted “domain experts”.
- Though the **All India Council for Technical Education (AICTE) has developed and updated model curricula for various engineering courses,** they draw the broad contours of the programme and it is left to individual institutions to use these flexible frameworks for their individual institutions to work out the nitty-gritty details at a granular level.
- **Educational and industry leaders need to work** in tandem to align their curriculum and business strategy respectively to the broad goals of **national initiatives like Make in India, Start-Up India, Energy Policy and the National Action Plan on Climate Change (NAPCC).**

Indian manufacturing is undergoing a profound transformation due to **Industry 4.0 revolution. Indian engineering education system needs to rise to the occasion with radical reforms in curriculum and pedagogy** so that it trains engineers who are not only equipped with cutting-edge technical skills but also have crucial soft skills necessary for collaborative team work. Manufacturing is increasingly become data-driven, interconnected and automated. Given the rapidly changing technology landscape, continuous learning will be the norm and both engineering education and engineering students need to brace themselves to new realities. Every challenge is an opportunity to shine and flourish in tech-driven careers and roles and be a part of impactful growth that changes lives of the people for the better.