MEEd
ASME Mechanical Engineering Education Summit
INDIA

ASME
SETTING THE STANDARD

ENGINEERING EDUCATION SEMINAR

EMPOWERING NEXT GENERATION ENGINEERS

23rd September, 2024

Gujarat Technological University, Ahmedabad

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EXECUTIVE SUMMARY

The ASME Foundation India, in association with Gujarat Technological University, Ahmedabad and the ASME Mechanical Engineering Education Summit (MEEd), organised a one-day seminar titled 'Educational Reforms for the Modern Workforce: Integrating Industry and Research', on 23rd September, 2024 at GTU, Ahmedabad.

The event saw more than 200 participants including directors, faculty members, researchers and scholars from engineering colleges of Gujarat and leaders and senior professionals from manufacturing and software enterprises.

The seminar focused on implementing the National Education Policy 2020 and sparked important discussions about the need for a mechanical engineering curriculum that effectively combines theoretical knowledge with practical applications.

The first panel discussed how the multidisciplinary approach highlighted in NEP 2020 offers flexibility, allowing students to blend diverse fields of study. The panellists advocated for interdisciplinary learning, where students could major in mechanical engineering while pursuing minors in subjects like AI or data science to stay relevant in a fast-evolving job market. The panellists also underscored the importance of hands-on learning, where practical lab work could shape students' problem-solving skills, highlighting the significance of all-round skills in modern engineering roles.

In the second panel, the focus shifted to innovation and entrepreneurship, particularly in rural and urban contexts. The panellists illustrated how field visits and real-world engagements help students grasp societal challenges. The keynote talks further stressed that engineering education must evolve, integrating cutting-edge technologies like AI and IoT to foster an entrepreneurial mindset that extends beyond job-readiness to societal impact.

INAUGURAL SESSION

Welcome Remarks by **Mr. Madhukar Sharma, President and Director, ASME India Private Limited**

In his welcome address, Mr. Madhukar Sharma set the tone of the seminar by discussing the need to align engineering education with industry expectations to prepare students for professional roles. The discussion emphasised India's growing manufacturing and services sectors, the role of soft skills, and the country's potential to become a leading technology nation. balanced and dynamic educational structure to prepare students for diverse career paths, including research and entrepreneurship.

ASME and MEEd Summit

ASME provides guidance and advocacy to mechanical engineering colleges and universities to enhance the quality, content, and relevance of engineering programs. It is an influential forum for academicians, researchers and industry leaders in mechanical engineering. ASME Mechanical Engineering Education (MEEd) Summit is a focussed seminar for leaders in mechanical engineering and mechanical engineering education.

- ASME is the leading international developer of standards associated with the practice of mechanical engineering since 1884, with its standards accepted for use in more than 100 countries including in India.
- ASME is committed to growing the engineering profession and empowering the future workforce through programs focused on students and faculty, including plans to introduce new professional development initiatives.
- The seminar focuses on bringing together engineering faculty and industry professionals on a single platform and aims to discuss the needs of the industry in terms of teaching methods and preparing students for professional roles.

Context Setting by **Dr. U. Chandrasekhar, Consultant, Engineering Education, AFI**

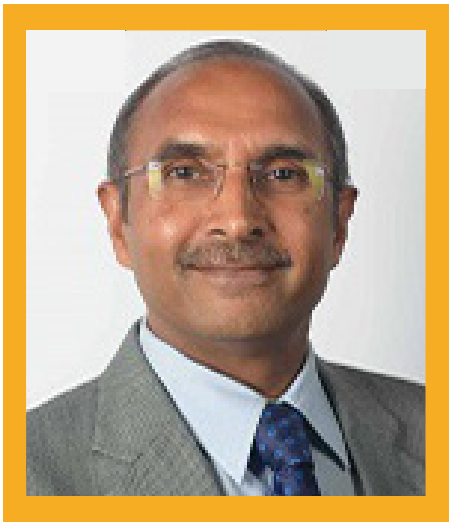
Dr. U. Chandrasekhar set the context for the 'Educational Reforms for the Modern Workforce: Integrating Industry and Research' seminar. He discussed the evolution of engineering education in response to technological advancements, particularly the impact of Industry 4.0 and AI on business and education and emphasised the need for a paradigm shift in engineering education to prepare the next generation of industry contributors. He also highlighted ASME's role in fostering best practices and transforming engineers into professionals capable of contributing to national and global endeavours, including sustainability and the circular economy.

Key highlights from the session:

- Engineering education has undergone a paradigm shift due to the infusion of new technologies like automation, AI, and machine learning. This has made it imperative to rethink how engineering courses are designed and delivered.
- ASME, with its core philosophy of enabling best practices in engineering education, has been conducting programs at reputed institutions for many years to address this need.
- The primary objective is to minimise the time it takes for an engineering graduate to start contributing effectively in industry, by bridging the gap between academia and industry.
- The program brings together industry leaders and practitioners alongside experienced academic professionals to create pathways for transforming engineering students into industry-ready contributors.

KEYNOTE ADDRESS

Keynote Address by **Mr. Yogi Sriram, Consultant-Strategic Human Resources, Governing Council**



The keynote address presented by Mr Yogi Sriram focused on the evolution of India's education policies and the implementation gaps, emphasising the target of Gross Enrolment Ratio of 50% by 2035. Mr Sriram said that the NEP 2020 aims to enhance educational standards while upholding secularism and socialism. He highlighted the importance of critical thinking, problem-solving, and cognitive biases, using examples like the "Blue-Eyes, Brown-Eyes" experiment and the role of Stanislav Petrov, who prevented the nuclear war between the Soviets and the US in 1983.

India's Education Policies and NEP 2020

- India has implemented three national policies on education since its Independence, the first in 1968, the second in 1986 and the latest National Education Policy, 2020.
- The NEP 2020 focuses on cognitive capabilities, literacy, and humanism, along with critical thinking and problem-solving skills.
- The main values of our education policies are secularism, socialism and democracy, which are enshrined in the Preamble of our Constitution.
- Faculty must consider how they can incorporate these values into their teaching to enhance students' understanding of discrimination.

Jane Elliott's 'Blue-Eyes, Brown-Eyes' experiment & Impactful Teaching Methods

- Faculty should design bold and impactful experiments to teach students, similar to Jane Elliott's 'Blue-Eyes, Brown-Eyes' exercise in 1968 to teach third grade students about discrimination after the assassination of Martin Luther King Jr.
- The experiment involved dividing students based on their eye colour and treating them differently to illustrate the negative effects of discrimination.
- The exercise was designed to help students understand and feel the impact of discrimination, leading to a life-changing experience for many participants.

AI, Critical Thinking and Cognitive Biases

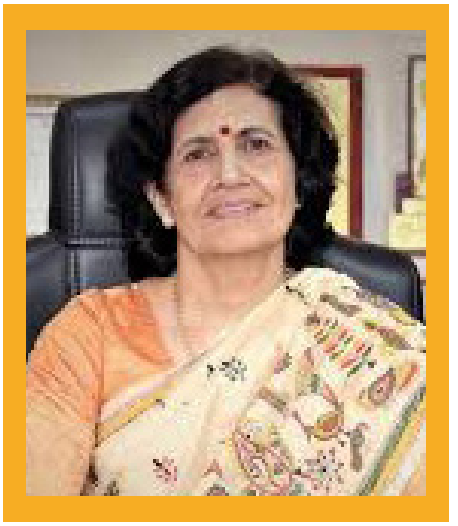
- Critical thinking is essential for problem-solving and decision-making. Strategic thinking is crucial for leadership.
- Study various types of cognitive biases such as anchoring bias, confirmation bias, and hindsight bias in depth and understand how they can influence decision-making.
- Form an understanding of cognitive biases in AI algorithms to prevent perpetuating existing biases.
- Cognitive biases in AI algorithms can lead to unfair, inaccurate, and potentially harmful outcomes by reinforcing human prejudices and errors in decision-making.

Research and Collaboration between industry and academia

Larsen & Toubro is collaborating with higher education institutions on the following programs:

- MTech and PhD programs with research at IIT Bombay
- MTech program with DIAT University, Pune
- Research projects in water technology with Anna University
- Research on Hyperloop Technology with IIT Madras

Presidential Address by
Dr. Rajul K. Gajjar,
Vice Chancellor, GTU



The presidential address by Dr. Rajul K. Gajjar emphasised the importance of cooperation and collaboration among industry, government, and academia. Dr. Gajjar highlighted Gujarat Technological University's success in creating an ecosystem that integrates emerging technologies, multidisciplinary projects, and skill enhancement programs, exemplified by 102 patents granted and 750 registered startups

Gujarat Technological University (GTU)

Gujarat Technological University (GTU), founded in 2007 by the Government of Gujarat, is a leading academic and research institution. It comprises 486 affiliated colleges across six zones in Gujarat, including Ahmedabad, Gandhinagar, Vallabh Vidyanagar, Rajkot, Surat and Bhuj. GTU focuses on fields such as Engineering, Architecture, Management, Pharmacy, and Computer Science, positioning itself as a hub for innovative ideas and scholarly pursuits.

Here are the key highlights from the session:

Creating a Collaborative Ecosystem

Academia, industry, and government are uniting to create an ecosystem to address the common challenges for the students and society. This collaboration facilitates the exchange of knowledge and resources, leveraging the strength of each of the sectors. Ultimately, it promotes innovation and develops impactful solutions for real-world problems.

Addressing Industry Needs and NEP 2020 Implementation

Gujarat excels in implementing the National Education Policy, 2020 through its robust collaboration among academia, industry, and government. GTU fosters a strong research ecosystem, partnering with prestigious institutes like SAC, ISRO, and IPR, while emphasising multidisciplinary and project-based learning. By aligning educational policies with industry needs, GTU ensures that research has a meaningful social and industrial impact.

Sustainability

GTU is deeply entrenched in the innovation ecosystem, with a focus on addressing the Sustainable Development Goals (SDGs) in their research and innovation projects. One of the major considerations while evaluating startup and research projects is which of the SDGs the project is addressing.

Core Sessions

PANEL DISCUSSION 1

Panelist

Mr. Kamalesh Mehta,
CEO at Citizen Industries Limited

Dr. Souvick Chatterjee,
Senior Team Lead, Principal Customer Success Engineer, MathWorks

Mr. Anand Patel,
Director at Gujarat Apollo Industries Ltd

Dr. Vishvesh Badheka,
Professor, ME, PDEU

Chairperson

Mr. Kamalesh Mehta,
CEO at Citizen Industries Limited

Multidisciplinary and industry relevant education for effective implementation of NEP 2020

The first panel discussion of the seminar was chaired by Mr. Kamalesh Mehta, CEO of Citizen Industries Limited. Mr Mehta opened the discussion by outlining the National Education Policy 2020, which replaces the 1986 policy and aims to provide high-quality education with a focus on cognitive and social-emotional skills. The policy is based on five pillars: access, equity, quality, affordability, and accountability. It introduces a new curriculum structure of 5+3+3+4 years, with focus on early childhood education and foundational literacy. The policy also encourages multidisciplinary education, foreign universities to set up campuses in India, and flexible undergraduate programs with multiple entry and exit points.

Key features of National Education Policy 2020

- The policy was announced by the Indian cabinet on July 29, 2020
- The new curriculum structure of 5+3+3+4, focuses on early childhood care and education, foundational literacy and numeracy, and developing social and emotional skills.

- The first stage (foundation course) includes preschool education and classes 1 and 2, with a focus on foundational education through activity-based learning.
- The second stage (preparatory course) covers classes 3 to 5, focusing on basic skills in speaking, reading, writing, and subjects like math and science.
- The third stage (middle education) includes classes 6 to 8, introducing students to more advanced subjects like physics, chemistry, social science, arts, and humanities.
- The fourth stage is divided into two parts: classes 9 and 10, and classes 11 and 12, focusing on multidisciplinary studies and multiple options.
- Report cards will provide comprehensive information about students, including mental health support through the deployment of counsellors and social workers.
- Higher education will offer multidisciplinary courses, with IITs encouraged to promote multidisciplinary studies.
- A new graduation structure is proposed, with certificates provided after one year of study, diplomas after two years, bachelor's degrees after three years, and multidisciplinary degrees after four years.
- Undergraduate courses can be completed in two years or two and a half years, with a flexible credit system allowing students to complete more than 20 credits in a term.
- Foreign universities are encouraged to set up campuses in India, and the policy emphasises the importance of India's traditional knowledge system and entry norms for the foreign universities.

ENGINEERING EDUCATION SEMINAR
Empowering Next Generation Engineers
Gujarat Technological University, Ahmedabad
Dr. Rajul Gajjar
Mr. Madhukar Sharma

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HELP DESK

Multidisciplinary and Industry relevant education for effective implementation of NEP 2020

The panel discussion focused on the benefits of interdisciplinary education in research and industry. Dr. Souvick Chatterjee discussed how understanding biological processes like fluid dynamics observed in mosquitoes can inspire engineering solutions. Dr. Vishvesh Badheka explained that the National Education Policy 2020 allows students to major in one field and minor in another, fostering interdisciplinary skills. He emphasised the importance of skill development, including practical lab work and the integration of AI in education. Mr. Anand Patel stressed the need for teamwork, communication, and Excel skills in engineering roles, suggesting practical applications of MATLAB and spreadsheet modelling in education.

Key highlights from the discussion:

- Explore the possibility of introducing major and minor subjects in the curriculum to promote interdisciplinary learning.
- Integrate the use of AI and Large Language Models (LLM) to assist in communication and presentation skills.
- Emphasise the importance of spreadsheets and basic programming skills for mechanical engineers. Engineers should be able to interpret insights from data, especially in management roles.
- The National Education Policy 2020 aims to provide students with a comprehensive understanding of multiple areas of interest. The panellists emphasised the need for students to develop a skill set that is aligned to their interests and future careers.
- Explore ways to incorporate project-based learning and industry-relevant content into the academic curriculum, including hands-on and simulation-based learning in the labs to enhance practical skills.
- Encourage professors to actively engage with industry to understand their requirements and help students develop the necessary skills.
- Develop a structured ecosystem between academic institutions and industry for internships, for instance the US offers flexibility in educational programs, allowing students to take breaks for internships to gain practical experience and job offers.

Keynote Talk by
Dr. Amit Prashant,
Professor IIT Gandhinagar

The keynote talk focused on integrating innovation into mechanical engineering education. Dr Prashant discussed how the traditional mechanical engineering practices are evolving with the integration of electronics and a shift towards Industry 4.0. He highlighted the importance of relevant curriculum updates to prepare students for industry demands, emphasising on experiential learning and contextual tools. He stressed on the necessity of teaching prototyping, end-to-end manufacturing, and advanced technologies like AI and IoT. He said that the goal is to make mechanical engineering education relevant and future-oriented, moving beyond a job-focused approach to include entrepreneurial skills and startup culture.

research ecosystem, partnering with prestigious institutes like SAC, ISRO, and IPR, while emphasising multidisciplinary and project-based learning. By aligning educational policies with industry needs, GTU ensures that research has a meaningful social and industrial impact.

Here are the highlights from the keynote talk:

Innovation in Mechanical Engineering Education

- Introduce data science and machine learning into mechanical engineering curriculum.
- Incorporate elements of electronics, instrumentation, and automation into the mechanical engineering program.
- Develop projects and learning experiences that allow students to choose the relevant tools and technologies to solve real-world problems.
- Explore ways to break away from the traditional job-centric mindset and instead focus on fostering an entrepreneurial culture among students.
- Ensure that faculty members are aware of the latest Industry 4.0 technologies and can effectively communicate their relevance to students.

Sustainability and Circular Economy

- The primary objective of sustainability is to improve lifestyle with less consumption of resources, and fulfilling this objective needs innovative approach.
- Innovation in batteries and alternative products is necessary to reduce energy consumption.
- India has promised to cut its emissions to net zero by 2070.
- India is working on the development of circular economy (CE) action plans for different categories of waste including plastic waste, batteries and e-waste.

Technology and Social Entrepreneurship

- Explore the “Living Lab” concept, where universities adopt centres to test and develop socially beneficial products and create a group to pursue funding opportunities for product development and method development.
- Incorporate sociological understanding, design thinking, and philosophy in engineering education and practice.
- Leverage the impact of technology on reducing inequality and maximising benefits to society.
- Address the security and privacy threats associated with the misuse of technology.

PANEL DISCUSSION 2

Panelist

Dr. Amit Prashant,
Professor, IIT Gandhinagar

Mr. Sanjay Desai,
MD, RBD Engineers

Mr. Jigish Shah,
Vice President,
Design & Development,
Milacron India Pvt Ltd

Prof. U. Chandrasekhar,
Consultant, Engineering
Education, AFI

Chairperson

Dr. Amit Prashant,
Professor, IIT Gandhinagar

Innovation and social entrepreneurship models in Indian Higher Education System

The second panel discussion of the seminar focussed on the role of academic institutions in fostering innovation and entrepreneurship. The panellists emphasised on the need for a dynamic education system that encourages questioning and problem-solving. They informed that the ecosystem for entrepreneurship in major cities of India like Ahmedabad, Hyderabad, Bengaluru, and Pune is mature, with support from incubation centres as well as state and central bodies.

Key highlights from the discussion:

- The traditional academic framework needs to foster innovation and entrepreneurship, as students are now more interested in developing solutions rather than just theoretical knowledge.
- Different educational systems should adopt models based on their specific context, such as rural or urban settings, or strong agriculture or manufacturing sectors.
- Incorporate programs or field visits that allow students to directly engage with communities and understand

their problems, especially in areas like agriculture, manufacturing, and traditional businesses.

- IIT Delhi offers a flagship course to first-year students called 'Introduction to Engineering', where students are encouraged to think about solving real-world problems through engineering.
- IIT Gandhinagar offers Design, Innovation and Prototyping course and Invention Factory program to foster innovation.
- Review and update the curriculum to match the job descriptions for mechanical engineering students by including interdisciplinary skills like automation, programming, and data analysis.

IIT Gandhinagar's Explorer Fellowship

IIT Gandhinagar offers a voluntary program to its students called the Explorer Fellowship. The fellows explore at least six states including one in South, North and Northeast for a continuous period of six weeks on Rs900 per day. They live on the road, travel by sleeper class on trains or by state government buses, and stay at low-cost accommodations such as youth hostels. It is a continuous learning process as fellows are encouraged to organise their trip around a specific theme like cuisines, folklore, oral history, indigenous technology etc, make presentations at the end of their travels and post it on the college website. The fellowship objective is to give the students exposure to real-world problems and societal issues.

Entrepreneurship Ecosystem In India

- The i-Hub incubation centre in Gujarat provides grants ranging from ₹ 2.5 lakh to ₹ 30 lakh to entrepreneurs and support for startups, helping students to develop and scale their ideas.
- The panellists discussed that mentorship and business planning ensure the sustainability of startups and avoid "valley of death" scenarios in startup development.

Successful Social Entrepreneurship Models in India

- MIT-graduate Sidhant Pai's social enterprise project Protoprint in Pune works with a waste-picker NGO to turn collected HDPE plastics into valuable, eco-friendly 3D printer filament using low-cost and decentralised technology interventions and

provides a market-driven solution to increase waste-picker incomes while also increasing profitable recycling avenues for the city.

- Enable is a digital network with global volunteers that provides free prosthetic limbs. Volunteers scan limb data via mobile phones, upload it to the cloud for medical experts to create designs, and 3D-print custom prosthetics. Local volunteers then deliver and fit the limbs, offering a cost-effective and customised solution to improve lifestyle.

Faculty's Role in Innovation and Entrepreneurship

- Faculty play a crucial role in fostering entrepreneurship by mentoring students and helping them avoid common pitfalls, while also creating a supportive environment for entrepreneurial ideas.
- The promotion of entrepreneurship in academic institutions includes initiatives like Technology Business Incubators (TBIs) and Startup India mission aimed at encouraging innovation among students.
- Bringing experienced entrepreneurs into faculty roles enhances student learning through mentorship and real-world insights, while encouraging collaboration with industry for shared benefits.
- The establishment of over 10,000 tinkering labs in high schools across India highlights the importance of hands-on experience in prototype development, emphasising the need for faculty to connect students with available resources and funding.

Funding and Support for Entrepreneurship

- The Ministry of Electronics and Information Technology sponsors incubation systems for new-generation entrepreneurs in IT, electronics and AI/ML fields.
- Nidhi Prayas provides up to Rs10 lakh to convert concepts into working models or prototypes.
- The Ministry of MSME supports business incubators with funding up to ₹15 lakh for physical asset-oriented models of entrepreneurship.
- The Department of Biotechnology offers funding up to ₹49 lakh through BIRAC, with monthly sustenance allowance for entrepreneurs.

Education That Inspires - Sustainability in Engineering

The session 'Education That Inspires - Sustainability in Engineering' was presented by Ms. Avni Malhotra. She discussed ASME Foundation's initiatives in India, focusing on sustainability and community impact. She elaborated on the ways that the foundation enhances engineering education and employability globally, supported by numerous events and programs through three main strategies: the education that inspires, careers that matter, and ideas that innovate.

Ms. Avni Malhotra,
Deputy Director,
ASME Foundation India

Education That Inspires

- ASME has various programs to reach different age groups, including K-12 outreach to engage school students in understanding engineering.
- ASME is collaborating with Super 30-allied organisation to educate students about engineering and its branches, helping them become better and more employable engineers.
- College programs like E-Fests and EFx are run and managed by students and include multidisciplinary workshops and technical competitions.
- Competitions like SDC (Student Design Competition) and IAM3D (Innovative Additive Manufacturing 3D) foster collaboration and practical skills among engineering students.
- ASME also offers scholarships to people of colour and women in mechanical engineering.

Careers That Matter

- ASME offers Engineering for Change (E4C) fellowships focussed on sustainability and aligned with SDGs (Sustainable Development Goals) to BTech graduates and final-year students.
- E4C fellow Nishant Agarwal, an IIT Kanpur graduate, developed his startup lifeandlimb.ai with focus on creating customised prosthetics.
- ASME also offers Graduate Teaching Fellowship.

Ideas That Innovate

- ASME programs provide seed capital, technical expertise and business insights to early-stage social entrepreneurs.
- ASME's ISHOW program promotes innovations and incubate innovation labs and PhD scholars to develop products from concept to launch.
- Eight ISHOW innovations are shortlisted for a competition, with a panel of eight judges evaluating them and awarding $10,000 to the winners.

RECOMMENDATION

The seminar presented a compelling case for reimagining engineering education in India, urging institutions to not only align with NEP 2020 but also address the needs of a dynamically changing global industry. Based on the discussions, the following recommendations are proposed:

1. Cultivate Interdisciplinary Learning:

Expand curricula to offer students the flexibility to blend engineering disciplines with fields like data science, AI, and social sciences. As highlighted by Dr. Souvick Chatterjee, cross-disciplinary insights - such as using biological processes like fluid dynamics observed in mosquitoes can inspire innovative solutions. This will prepare students to tackle complex problems requiring a holistic understanding.

2. Promote Experiential Learning:

Paradigm shift from rote learning to project-based and hands-on education is vital. As discussed by panellists, practical skills like basic coding skills and data analysis are essential for engineering roles today.

3. Strengthen Industry-Academia Research and Project Collaboration:

Academic institutions must deepen their engagement with industries. Inspired by models from institutions like GTU and IIT Gandhinagar, internships and projects should be integrated into the curriculum to provide students with exposure to the challenges industries face and the tools needed to solve them.

4. Foster Innovation and Entrepreneurship:

Encourage students to pursue entrepreneurial paths by embedding courses that focus on creating solutions for real-world challenges. Drawing on programs like IIT Delhi's 'Introduction to Engineering' and field visits that connect students with rural communities, engineering education should foster a mindset of innovation aimed at addressing India's unique social and industrial needs.

5. Empower Faculty with Industry Insights:

Faculty members must stay current with emerging technologies and entrepreneurial trends. Bringing in seasoned entrepreneurs as faculty members, as suggested during the seminar, would help bridge the gap between academia and the demands of the industry, ensuring students receive mentorship grounded in practical and real-world experiences.