Upcoming Mechanical Engineering Techniques

Krishna Kumar K
Hawassa University.

Habtamu Bekele
Hawassa University.

Abstract:

Future mechanical engineers will need to be creative, adept at problem solving, and able to take a multidisciplinary, systems level understanding of problems. Future engineers will need to be life-long learners adept at turning information into knowledge and mastering new skills. Analysis, design, and synthesis are the key functions of mechanical engineers trends in the scientific and technological world indicate rapid transformations in the scope of mechanical engineering.

Mechanical engineers will continue to lead the world in providing significant contributions to the essential sectors including energy & environment, manufacturing, transportation, waste management and health & medical care. Mechanical engineers need to be trained not only in the traditional fundamental areas, but also in the emerging Interdisciplinary areas.

Nanotechnology, Mechatronics ,Micro Electro Mechanical System, Nuclear power ,Adaptive Control System, Automation, Simulation and Hydrogen Engineering will have prominent places in the future development of mechanical engineering as a discipline.

Keywords:
Energy, Design, Manufacturing, Communication, Material, Transportation.

Introduction:

The world of engineering is rapidly changing in its content, scope and expectations. By 2028, advances in computer aided design, materials, robotics, nanotechnology and biotechnology will democratize the process of designing and creating new devices. Engineers will be able to design solutions to local problems. Individual engineers will have more latitude to design and build their devices using indigenous materials and labour – creating a renaissance for engineering entrepreneurs.

The engineering workforce will change as more engineers work at home as part of larger decentralized engineering companies or as independent entrepreneurs. Advancement in the engineering tools required for the growth of technological knowhow has been catalytic in the recent achievements and the ones to come in the near future.

The enthusiasm associated with this uphill growth is evident in all areas of engineering. Mechanical engineering, being one of the fundamental disciplines in engineering is no different. However, the success of mechanical engineers and our profession depends on how well we can adapt to these changes and thus excel in facing the challenges ahead.

Trends in the world of Technology:

Energy, Communication and Health are the three broad areas of development today and in the decades to come. Almost all sectors of development can be categorized under these three vast divisions. The areas that can be classified under the broad domain of Energy are power generation, manufacturing, materials, and transportation among others. Similarly, sectors such as information technology, education & training and entertainment come under Communication. The sectors coming under Health are typically medical care, sports, and food.

Apart from these broad disciplines, there are many vital areas of interest such as environmental sciences & technologies and safety engineering, which are relevant to all the three broad disciplines alike. New and emerging technologies in any of the sectors need to be consistent with the environmental and safety requirements. The parameters that determine the standard of achievement in any subdivision will be precision, quality & efficiency.

Other crucial parameters include economy, reliability and acceptability. Technologies and applications tend to become increasingly automated to maintain these standards and thus survive in the intense competition. To put it in a nutshell, it's going to be the survival of the fittest in a world of exceptional technologies.

Role of Mechanical Engineering:

How do all these affect the future of mechanical engineering? Mechanical engineering has been one of the fundamental disciplines of engineering and has undergone significant changes to accommodate the emerging trends in the scientific and technological sectors. This resulted in mechanical engineers getting actively involved in interdisciplinary areas such as robotics. We have embraced many technical aspects that were monopolies of other scientific and engineering disciplines

and redefined the destiny of them by our dominance in finding the most versatile applications. The Society is focusing on specific technologies such as high-temperature heat flux heat reduction, heat pump hot water supply, micro- & nano-biomechanics, automobile fuel efficiency and energy machine efficiency.

The key areas of development where mechanical engineering is going to play a major role are Nanotechnology and biotechnology will dominate technological development in the next 20 years and will be incorporated into all aspects of technology that affect our lives on a daily basis. Nano-Bio will provide the building blocks that future engineers will use to solve pressing problems in diverse fields including medicine, energy, water management, aeronautics, agriculture, tidal energy and environmental management.

Design & Manufacturing:

Engineers involved in the design and manufacturing sectors will continue to utilize the benefits of Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM). The heart of a successful CAD/CAM system will always have a foundation built on the fundamental principles of mechanical engineering. Flexible Manufacturing System (FMS),Computer Integrated Manufacturing (CIM) techniques are used by companies worldwide. Robotics & Automation are widely used in the automotive and process industries.CIM and robotics are undergoing rapid changes and will continue to do so in the coming decades.

Artificial Intelligence (AI) is all set to define the future of automation, JIT, Lean, Concurrent Engineering, Reverse Engineering, e-Manufacturing. Finite Element Analysis (FEA) of systems is becoming increasingly reliable with custom-made software for costly projects requiring precision. Computational Fluid Dynamics (CFD) is vital for industries in the automotive, aerospace and naval sectors.

Development in these advanced tools and techniques depend largely on inputs from mechanical engineers. Failure Modes, Effects and Criticality Analysis (FMECA), Design For Manufacturing and Assembly (DFMA) is regarded as a global standard throughout the design review process. In the next few decades, the world of mechanical engineering is going to witness sweeping transformations in CAD/CAM, FEA, CFD and FMECA, DFMA.

Transportation & Environment:

Latest trends in the automotive sector points to a "zero emission" concept that is not too far from now. Continued research and development in hybrid technology and new fuel blends require tremendous effort from mechanical engineers. Automotive research and development will boost up in the coming decades. Better propulsion methods and improved combustion technologies are the answers to the concerns of current vehicle technologies. Other sectors that will maintain the fast-paced development include vehicle structural design, manufacturing techniques, control systems and safety engineering.

The use of better technologies also contributes a great deal to other forms of transportation like rail, ships and airplanes, Another type of Zero-Emission Vehicle is the fuel cell powered vehicle. The aim of every transportation system in the coming years will be to transport maximum passengers or goods with minimum hardware and time in the safest manner.

Power Generation & Environment:

The quest for energy sources will continue in the decades to come. Sustainable development necessitates careful utilization of energy resources in a way that is environmentally benign and economically feasible. Probable developments in the power generation techniques include enhanced use of hydrogen as an energy source, nuclear fusion in controlled condition and energy from waste materials.

The fundamental research & development, design & maintenance of energy systems and project management in these sectors need invaluable contribution from mechanical engineers. Mechanical engineering has got the final say in any system meant for mitigation of global warming or prevention of ozone layer depletion.

Waste Management:

This is going to be an all-time issue. Developments in this direction lead to "zero waste" concept in the industrial, commercial and domestic sectors. They also deal with technologies that develop new products with high utility value from waste material. The "zero waste" concept calls for dealing thoroughly with every product right from its concept-level to dismantling. This requires use of modern techniques like concurrent engineering in the design and development of products. The area of waste management offers immense opportunities for mechanical engineering.

Health & Medical Care:

Research and development in the coming decades will focus more toward a "total health" concept in the health & medical care sector. Advancements in this field require development of precision instruments and other medical equipment.

Mechanical engineers have immense opportunities to contribute in this sector. Moreover, fundamental principles of mechanical engineering including thermodynamics, heat transfer and fluid mechanics will find themselves increasingly important in understanding the human body better. Any major development in the medical sector will involve the services of mechanical engineers.

Mechanical Engineering Education:

In 2028, the ability of individuals and organizations to learn, innovate, adopt and adapt faster will drive advanced economies. Mechanical engineering education will be restructured to resolve the demands for many individuals with greater technical knowledge and more professionals who also have depth in management, creativity and problem-solving.

Education and training for mechanical engineers are important for them to become up-to-date with the emerging trends and innovations in the field. Advances in other disciplines of engineering are also potential cues for mechanical engineers as well as Electro Mechanical Engineering. Mechanical engineering education consists of learning the core areas (fundamental principles), transitional areas (developed over the years and still developing), future areas (emerging and envisioned) and interdisciplinary areas (those related to other disciplines in engineering and which are required to be mastered).

Learning mechanical engineering takes place at different levels such as university programs (leading to degrees), career continuing education programs and skills enhancement courses. Electro Mechanical Engineering learning takes place at advanced levels to Electronics and mechanical system like Artificial Intelligence, Mechatronics System, Adaptive control system and MEMS.

Engineering knowledge and skill is vital for the competiveness of modern societies. Newly industrialized countries are keenly aware of the advantages of engineering and are dramatically increasing the numbers of engineers they graduate annually. India, China and Mexico are all increasing the numbers of engineers their universities and technical institutes produce.

University level education needs to be focused on the core and transitional areas and should give an insight into the future and interdisciplinary areas. Nevertheless, continuing education and skills enhancement courses need to provide emphasis on the future and interdisciplinary areas while ensuring the knowledge base in the core and transitional areas.

Educational opportunities in mechanical engineering are definitely going to rise in the coming years. A successful planning for providing advanced training should definitely include packages for all kinds of candidates such as full time students, practicing engineers, researchers and managers.

Futuristic Technologies:

Nanotechnology is going to be the crux of every engineering discipline. Breakthrough research in this scientific area leads to immense opportunities for betterment of existing areas such as production technology and aerosol science & technology. This is an area where mechanical engineers need to be trained well to face the challenges of the future. They will rely heavily on simulations and computer aided design in the development and management of complex systems.

Computer simulations will become better at modelling complex systems and will be a valuable tool for engineers to optimize expected outcomes while limiting unintended consequences.

Mechatronics is an area that could witness a giant leap in the coming years. Mechanical engineering is going to benefit from the developments in electronics, photonics and intelligent systems. The direct applications of these technologies in the automation of industries, robotics and manufacturing offer excellent possibilities for mechanical engineers.

Micro Electro Mechanical System is emerging area in the future for portable manufacturing and adaptive, reliable system with the collaboration of mechanical and electronic components.

Design For Manufacturing and Assembly (DFMA) is CAPP tool for manufacturing to Minimize parts, Design parts for multiply applications, Use modular design, Avoid tools and Simplify operations in upcoming manufacturing system.

The lean production system is a philosophy that embraces all aspects of industrial operations by focusing on the Reduction of waste from the value stream to remain competitive in a world driven economy.

Just-In-Time Manufacturing or JIT or Lean Manufacturing, is a philosophy of continuous improvement that puts emphasis on prevention rather than correction, and demands a companywide focus on quality. It is also an operational management approach to achieve world class manufacturing.

e-manufacturing emphases the new philosophy through which manufacturing will be operated in integration with Internet technology. e-manufacturing philosophy results Digitisation , Globalisation, Mobility, Collaborative work , Immediacy.

Hydrogen engineering is another notable sector in the coming years. The production, storage and use of this “most abundant, yet difficult to handle” element as a potential answer to world’s energy problems requires contribution from mechanical engineers more than anybody else. This area itself could likely branch out as a subspecialty of mechanical engineering just like aerospace engineering, production engineering, industrial engineering or automotive engineering.

Conclusion:

Engineers will work at the extremes of very large and very small systems that require greater knowledge and coordination of multidisciplinary and multi-scale engineering across greater distances and timeframes. A new field of systems engineering will incorporate much of the knowledge and practices of mechanical engineering. The future of mechanical engineering lies not only in the core sectors of energy, manufacturing, transportation and healthcare but also in emerging

disciplines like Nanotechnology, Automation, Mechatronics, Electro Mechanical, Artificial Intelligence, Adaptive Control System in Manufacturing and hydrogen engineering. Thus it is becoming increasingly imperative to further train mechanical engineers in the emerging interdisciplinary areas and recent technologies to meet the future challenges. Mechanical engineering will retain its luster and identity and at the same time enhance its scope and responsibilities in the coming decades to maintain its lead in the world of engineering.

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