Mechanical engineering

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Mechanical engineering is a discipline of engineering that applies the principles of engineering, physics and materials science for analysis, design, manufacturing, and maintenance of mechanical systems. It is the branch of engineering that involves the production and usage of heat and mechanical power for the design, production, and operation of machines and tools.[1] It is one of the oldest and broadest engineering disciplines.

The engineering field requires an understanding of core concepts including mechanics, kinematics, thermodynamics, materials science, structural analysis, and electricity. Mechanical engineers use these core principles along with tools like computer-aided engineering, and product lifecycle management to design and analyze manufacturing plants, industrial equipment and machinery, heating and cooling systems, transport systems, aircraft, watercraft, robotics, medical devices, weapons, and others.

Mechanical engineering emerged as a field during the industrial revolution in Europe in the 18th century; however, its development can be traced back several thousand years around the world. Mechanical engineering science emerged in the 19th century as a result of developments in the field of physics. The field has continually evolved to incorporate advancements in technology, and mechanical engineers today are pursuing developments in such fields as composites, mechatronics, and nanotechnology. Mechanical engineering overlaps with aerospace engineering, metallurgical engineering, civil engineering, electrical engineering, petroleum engineering, manufacturing engineering, chemical engineering, and other engineering disciplines to varying amounts. Mechanical engineers may also work in the field of Biomedical engineering, specifically with biomechanics, transport phenomena, biomechatronics, bionanotechnology and modeling of biological systems, like soft tissue mechanics.
Development

Applications of mechanical engineering are found in the records of many ancient and medieval societies throughout the globe. In ancient Greece, the works of Archimedes (287 BC–212 BC) deeply influenced mechanics in the Western tradition and Heron of Alexandria (c. 10–70 AD) created the first steam engine.[2] In China, Zhang Heng (78–139 AD) improved a water clock and invented a seismometer, and Ma Jun (200–265 AD) invented a chariot with differential gears. The medieval Chinese horologist and engineer Su Song (1020–1101 AD) incorporated an escapement mechanism into his astronomical clock tower two centuries before any escapement can be found in clocks of medieval Europe, as well as the world's first known endless power-transmitting chain drive.[3]

During the years from 7th to 15th century, the era called the Islamic Golden Age, there were remarkable contributions from Muslim inventors in the field of mechanical technology. Al-Jazari, who was one of them, wrote his famous Book of Knowledge of Ingenious Mechanical Devices in 1206, and presented many mechanical designs. He is also considered to be the inventor of such mechanical devices which now form the very basic of mechanisms, such as the crankshaft and camshaft.[4]

Important breakthroughs in the foundations of mechanical engineering occurred in England during the 17th century when Sir Isaac Newton both formulated the three Newton's Laws of Motion and developed Calculus, the mathematical basis of physics. Newton was reluctant to publish his methods and laws for years, but he was finally persuaded to do so by his colleagues, such as Sir Edmund Halley, much to the benefit of all mankind. Gottfried Wilhelm Leibniz is also credited with creating Calculus during the same time frame.

During the early 19th century in England, Germany and Scotland, the development of machine tools led mechanical engineering to develop as a separate field within engineering, providing manufacturing machines and the engines to power them.[5] The first British professional society of mechanical engineers was formed in 1847 Institution of Mechanical Engineers, thirty years after the civil engineers
formed the first such professional society Institution of Civil Engineers.[6] On the European continent, Johann Von Zimmermann (1820–1901) founded the first factory for grinding machines in Chemnitz, Germany in 1848.

In the United States, the American Society of Mechanical Engineers (ASME) was formed in 1880, becoming the third such professional engineering society, after the American Society of Civil Engineers (1852) and the American Institute of Mining Engineers (1871).[7] The first schools in the United States to offer an engineering education were the United States Military Academy in 1817, an institution now known as Norwich University in 1819, and Rensselaer Polytechnic Institute in 1825. Education in mechanical engineering has historically been based on a strong foundation in mathematics and science.

Coursework

Standards set by each country’s accreditation society are intended to provide uniformity in fundamental subject material, promote competence among graduating engineers, and to maintain confidence in the engineering profession as a whole. Engineering programs in the U.S., for example, are required by ABET to show that their students can "work professionally in both thermal and mechanical systems areas."[13] The specific courses required to graduate, however, may differ from program to program. Universities and Institutes of technology will often combine multiple subjects into a single class or split a subject into multiple classes, depending on the faculty available and the university's major area(s) of research.

The fundamental subjects of mechanical engineering usually include:

- Mathematics (in particular, calculus, differential equations, and linear algebra)
- Basic physical sciences (including physics and chemistry)
- Statics and dynamics
- Strength of materials and solid mechanics
- Materials Engineering, Composites
- Thermodynamics, heat transfer, energy conversion, and HVAC
- Fuels, combustion, Internal combustion engine
• Fluid mechanics (including fluid statics and fluid dynamics)
• Mechanism and Machine design (including kinematics and dynamics)
• Instrumentation and measurement
• Manufacturing engineering, technology, or processes
• Vibration, control theory and control engineering
• Hydraulics, and pneumatics
• Mechatronics, and robotics
• Engineering design and product design
• Drafting, computer-aided design (CAD) and computer-aided manufacturing (CAM)[14][15]

Bibliography