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Mechanical engineering definition for dummies

Mechanical engineering is the application of physical principles to the creation of useful devices, objects and machines. Mechanical engineers use principles such as heat, strength and mass and energy conservation to analyze static and dynamic physical systems, contributing to the design of things such as automobiles, aircraft and other vehicles, heating and cooling systems, household appliances, industrial equipment and machinery, weapons systems Etc. Mechanical engineers often create simulations of how objects work, as well as manufacturing processes to be used, to optimize performance, cost-effectiveness and energy efficiency, before settling on a particular design. Engineering drawings of the objects to be made are usually created. Before the end of the 20th century, most engineering drawings were hand-drawn using mechanical drafting boards. The advent of the digital computer with a graphical user interface has made it possible to create models and drawings using computer-aided design (CAO) programs. Most CAD programs now allow the creation of three-dimensional models that can be viewed from any angle. These models can be used as the basis for the analysis of the finished elements (FEA) of the design. Through the application of computer-aided manufacturing[?] (CAM), models can also be used directly by software to create instructions for the manufacture of objects represented by the models, by digitally controlled computer machining (CNC) or other automated processes, without the need for intermediate drawings. The fundamental subjects of mechanical engineering include: heat transfer, fluid mechanics, solid mechanics[?], pneumatics, hydraulics and applied thermodynamics. Related disciplines include; Electrical Engineering, Industrial Engineering, Systems Engineering, Aerospace Engineering and other engineering disciplines. See also List of mechanical engineers patent List of inventors A kind of field test of Fiat vehicles. Archimedes' screw was operated by hand and could effectively increase the water, as demonstrated by the animated red ball. Mechanical engineering is a branch of engineering that applies the principles of mechanical and materials science for the analysis, design, manufacture and maintenance of mechanical systems. It involves the production and use of heat and mechanical energy for the design, production and operation of machines and tools. They can range from the construction of a rocket ship to a modern car. It is one of the oldest and widest engineering disciplines. Topics Mechanical engineering generally include: Static and Dynamic Materials Force and Solid Mechanics Instrumentation and Measurement Electronics Thermodynamics, Heat Transfer, Energy Conversion, and CVC Combustion, Automotive Engines, Fluid Mechanics Fuels and Fluid Dynamics Mechanism Design (including Kinematics and Dynamics) Manufacturing Engineering, Manufacturing, Manufacturing, or mathematical hydraulic and pneumatic processes - in particular, calculus, differential equations, and linear algebra. Engineering Design Mecatronics Product Design and Control Theory Materials Engineering Design, Writing, Computer-Assisted Design (CAO) (including Solid Modeling) and Computer-Assisted Manufacturing (CAM) Mechanical Engineers are also expected to understand and be able to apply basic concepts of chemistry, physics, chemical engineering, civil engineering and electrical engineering. Most mechanical engineering programs include several semesters of computation, as well as advanced mathematical concepts, including differential equations, partial differential equations, linear algebra, abstract algebra and differential geometry, among others. In addition to the basic mechanical engineering program, many mechanical engineering programs offer more specialized programs and classes, such as robotics, transportation and logistics, cryogenics, fuel technology, automotive engineering, biomechanics, vibration, optics and others, if a separate department does not exist for these materials. Children's Images An oblique view of a four-cylinder online crank with FMS Training pistons with SCORBOT-ER 4u learning robot, established CNC Mill and CNC Lathe A CAD model of a mechanical double-joint composite fabric made of woven carbon fiber In order to continue to enjoy our site, we ask you to confirm your identity as a human being. Thank you very much for your cooperation. Engineering Discipline and Economics Mechanical EngineeringOccupationNamesMechanical engineerActivity sectorsapplied mechanical, dynamic, thermodynamic, Fluid mechanics, heat transfer, production technology, and otherDescriptionDescriptive technical knowledge, management skills, design (see also glossary of mechanical engineering)Education requiredSe the professional requirements belowThe fields of employment technology, science, exploration, military mechanical engineering is an engineering branch that combines engineering physics and mathematical principles with the science of materials to design , analyze, manufacture and maintain mechanical systems. It is one of the oldest and widest engineering branches. The field of mechanical engineering requires an understanding of fundamental areas, including mechanics, dynamics, thermodynamics, materials science, structural analysis and electricity. In addition to these fundamental principles, mechanical engineers use tools such as computer-aided design (CAO), computer-aided manufacturing (CAM) and product lifecycle management to design and design manufacturing plants, industrial equipment and machinery, heating and cooling systems, transportation systems, aircraft, personal watercraft, robotics, medical devices, weapons and others. It is the engineering industry that involves the design, production and operation of machines. [2] Mechanical engineering emerged as a field during the industrial revolution in Europe in the 18th century; However, its sound can be traced thousands of years around the world. In the 19th century, developments in physics led to the development of mechanical engineering science. The field has continued to evolve to integrate progress; today, mechanical engineers are pursuing developments in areas such as composites, mechatronics and nanotechnology. He also straddles aerospace engineering, metallurgical engineering, civil engineering, electrical engineering, manufacturing engineering, chemical engineering, industrial engineering and other engineering disciplines in varying quantities. Mechanical engineers can also work in the field of biomedical engineering, particularly with biomechanics, transport phenomena, biomecatronics, bionanotechnology and modeling of biological systems. Bugatti Veyron's W16 engine. Mechanical engineers design engines, power plants, other machines... structures and vehicles of all sizes. History Main Article: History of Mechanical Engineering The application of mechanical engineering can be seen in the archives of various ancient and medieval societies. The six classic simple machines were known in the ancient Near East. The corner and the sloped plane (ramp) were known since prehistory. [4] The wheel, with the wheel and axle mechanism, was invented in Mesopotamia (modern Iraq) during the 5th millennium BC. [5] The leverage mechanism appeared about 5,000 years ago in the Near East, where it was used in a simple scale of balance,[6] and to move large objects in ancient Egyptian technology. The lever was also used in the shadoof water lifting device, the first crane machine, which appeared in Mesopotamia around 3000 BC. The first traces of pulleys date back to Mesopotamia in the early 2nd millennium BC. Sakia was developed in the kingdom of Kush in the 4th century BC. It relied on animal power to reduce towing in line with human energy requirements. [9] Reservoirs in the form of Hafirs have been developed in Kush to store water and stimulate irrigation. Bloomeries and blast furnaces were developed in the 7th century BC. J.C. to Meroe. [11] [12] [13] Kushite sundials applied mathematics in the form of advanced trigonometry. [15] The first practical water machines, the water wheel and the water mill, first appeared in the Persian Empire, in what is now Iraq and Iran, in the early 4th century BC. In ancient Greece, the works of Archimedes (287-212 BC) influenced mechanics in the Western tradition. In Roman Egypt, Heron of Alexandria (c. 10-70 AD) created the first steam engine (Aeolipile). In China, Zhang Heng (78-139 AD) improved a water clock and invented a and Ma Jun (200-265 AD) invented a tank with differential gears. The medieval Chinese horologist and engineer Su Song (1020-1101 AD) incorporated an escape mechanism into his astronomical clock tower two centuries before escape devices were found in European medieval clocks. He also invented invented the world's first known endless power transmission chain. During the Islamic Golden Age (7th to 15th century), Muslim inventors made remarkable contributions in the field of mechanical technology. Al-Jazari, who was one of them, wrote his famous Book of Ingenious Devices in 1206 and presented many mechanical drawings. Al-Jazari is also the first known person to create devices such as the crank shaft and the cam shaft, which now form the basis of many mechanisms. In the 17th century, major breakthroughs in the foundations of mechanical engineering occurred in England. Sir Isaac Newton formulated Newton's Laws of Movement and developed Calculus, the mathematical basis of physics. Newton hesitated to publish his works for years, but he was eventually persuaded to do so by his colleagues, such as Sir Edmond Halley, to the benefit of all humanity. Gottfried Wilhelm Leibniz is also credited with creating Calculus during this period. At the beginning of the 19th century, machine tools were developed in England, Germany and Scotland. This has allowed mechanical engineering to develop as a distinct field within engineering. They brought with them manufacturing machines and engines to power them. The first British professional mechanical engineering company was formed in 1847 Institution of Mechanical Engineers, thirty years after civil engineers formed the first institution of this professional society of civil engineers. On the European continent, Johann von Zimmermann (1820-1901) founded the first mill in Chemnitz, Germany, in 1848. In the United States, the American Society of Mechanical Engineers (ASME) was established in 1880, becoming the third professional engineering company of its kind, after the American Society of Civil Engineers (1852) and the American Institute of Mining Engineers (1871). The first schools in the United States to offer engineering training were the United States Military Academy in 1817, an institution now known as Norwich University in 1819, and the Rensselaer Polytechnic Institute in 1825. Mechanical engineering education has always been based on a solid foundation in mathematics and science. [25] The Education Archimedes screw was operated by hand and could effectively increase the water, as the animated red ball demonstrates. Mechanical engineering degrees are offered at various universities around the world. Mechanical engineering programs typically take four to five years of study depending on the location and university and culminate in a bachelor's degree in engineering (ing. or B.E.), a bachelor of science (B.Sc. or B.S.), a bachelor's degree in scientific engineering (B.Sc.Eng.), a bachelor's degree in technology (B.Tech.), a bachelor's degree in mechanical engineering (B.M.E.) or a bachelor's degree in scientific engineering (B.Sc.Eng.), a bachelor's degree in technology (B.Tech.), a bachelor's degree in mechanical engineering (B.E.) or a bachelor's degree in mechanical engineering (B.E.) or a bachelor's degree in applied sciences (B.A.Sc.) , in or with emphasis in mechanical engineering. In Spain, Portugal and most of South America, where neither B.S. nor B.Tech programs. have not been adopted, the name is a mechanical engineer, and the course work is based on five or six years of training. In Italy, course work is based on five years of education, and training, but to be eligible as an engineer, you must pass a state exam at the end of the course. In Greece, courses are based on a five-year curriculum and the requirement for a degree thesis, which at the end of a degree is awarded rather than a B.Sc.[26] In the United States, most undergraduate mechanical engineering programs are accredited by the Accreditation Board for Engineering and Technology (ABET) to ensure similar course requirements and standards between universities. The IBET website lists 302 accredited mechanical engineering programs as of March 11, 2014. [27] Mechanical engineering programs in Canada are accredited by the Canadian Engineering Accreditation Council (CABA),[28] and most other countries offering engineering degrees have similar accreditation companies. In Australia, mechanical engineering degrees are awarded as a bachelor of engineering (mechanical) or similar nomenclature, although there are an increasing number of specializations. The diploma takes four years of full-time study to reach. To ensure the quality of engineering degrees, Engineers Australia accredits engineering degrees awarded by Australian universities in accordance with the Washington World Agreement. Before the diploma can be granted, the student must complete at least 3 months of work experience at an engineering firm. [29] Similar systems are also present in South Africa and are overseen by the Engineering Council of South Africa (ECSA). In India, to become an engineer, you must have an engineering degree such as a B.Tech or B.E., have an engineering degree, or complete a course in an engineering trade such as fitter from the Industrial Training Institute (ITIs) to receive an ITI trade certificate and also pass the commercial test of all of India (AITT) with an engineering trade carried out by the National Council of Vocational Training (NCVT) by which a certificate is awarded. A similar system is used in Nepal. [30] Some mechanical engineers are pursuing a master's degree in engineering, a master's degree in technology, a master's degree in engineering management (M.Eng.Mgt. or M.E.M.), a doctorate in philosophy in engineering (eng.D. or Ph.D.) or an engineering degree. Master's degrees and engineering degrees may or may not include research. The Doctor of Philosophy has an important research component and is often considered the entry point into academia. [31] The engineering degree exists in a few institutions at an intermediate level between master's and doctoral degrees. The course standards set by each country's accreditation company are aimed at standardize core subjects, promote the competence of graduate engineers and maintain confidence in the engineering profession as a whole. Engineering programs in The United States, for example, is required by ABET to show that its students can work professionally in the fields of thermal and mechanical systems. [32] However, the specific courses required to graduate may differ from one program to another. Universities and institutes of technology often combine multiple subjects into a single class or divide a subject into several classes, depending on the faculty available and the university's main research area. The fundamental subjects of mechanical engineering generally include: Mathematics (in particular, calculation, differential equations, and linear algebra) Basic physical sciences (including physics and chemistry) Static and Dynamic Materials Force and Solid Mechanics Materials engineering, Thermodynamic composites, heat transfer, energy conversion, and CVC fuels, combustion, fluid mechanics of internal combustion engines (including fluid static and fluid dynamics) Mechanism and machine design Kinematics and Dynamics) Instrumentation and Measurement Manufacturing Engineering, Technology, or Vibration Process, Control Theory and Engineering Of Hydraulic and Pneumatic Control Mechatronics and Robotics Engineering Design and Product Design Writing, Computer-Assisted Design (CAO) and Computer-Assisted Manufacturing (CAM)[33][34] Mechanical engineers are also expected to understand and be able to apply basic concepts of the , physics, tribology, chemical engineering, civil engineering and electrical engineering. All mechanical engineering programs include several semesters of mathematical classes, including numeracy, and advanced mathematical concepts, including differential equations, partial differential equations, linear algebra, abstract algebra, and differential geometry, among others. In addition to the basic mechanical engineering program, many mechanical engineering programs offer more specialized programs and classes, such as control systems, robotics, transportation and logistics, cryogenics, fuel technology, automotive engineering, biomechanics, vibration, optics and others, if a separate department does not exist for these materials. [35] Most mechanical engineering programs also require varying amounts of research or community projects to gain hands-on problem-solving experience. In the United States, it is common for mechanical engineering students to complete one or more internships during their studies, although this is generally not prescribed by the university. Cooperative education is another option. Future professional skills[36] research puts demand on study components that creativity and innovation of the student. [37] Work functions Mechanical engineers research, design, develop, build and test mechanical and thermal devices, including tools, motors, and machines. Mechanical engineers generally do the following: Analyze problems to see how mechanical and thermal devices can help solve the problem. Design or redesign mechanical and thermal devices using computer-aided analysis and design. Computer. and test prototypes of the devices they design. Analyze test results and modify design as required. Supervise the manufacturing process of the device. Mechanical engineers design and oversee the manufacture of many products ranging from medical devices to new batteries. They also design energy-producing machines such as electric generators, internal combustion engines, steam and gas turbines, and energy-using machines, such as refrigeration and air conditioning systems. Like other engineers, mechanical engineers use computers to help create and analyze designs, run simulations and test how a machine is likely to work. License and Regulation Engineers can apply for a licence from a state, provincial or national government. The purpose of this process is to ensure that engineers have the necessary technical knowledge, real-world experience and knowledge of the local legal system to practice engineering at the professional level. Once certified, the engineer is awarded the title of professional engineer (in the United States, Canada, Japan, South Korea, Bangladesh and South Africa), a certified engineer (in the United Kingdom, Ireland, India and Zimbabwe), a certified professional engineer (in Australia and New Zealand) or a European engineer (a large part of the European Union). In the United States, to become a Certified Professional Engineer (PE), an engineer must pass the Complete FE (Fundamentals of Engineering) exam, work at least 4 years as an engineering trainee (EI) or engineer-in-training (EIT), and pass the Principles and Practice or PE (Practitioner Engineer or Professional Engineer) exams. The requirements and steps of this process are set out by the National Council of Examiners for Engineering and Surveying (NCEES), a group of engineering licensing and land survey boards representing all U.S. states and territories. In the UK, current graduates need a BEng plus an appropriate master's degree or an integrated MEng degree, a minimum of 4 years of graduate studies on professional skills development and a peer-reviewed project report to become a Certified Mechanical Engineer (CEng, MIMechE) through the Institution of Mechanical Engineers. CEng MIMechE can also be obtained through an exam course administered by the City and Guilds of London Institute. [38] In most developed countries, certain engineering tasks, such as the design of bridges, power plants and chemical plants, must be approved by a professional engineer or a certified engineer. Only a licensed engineer, for example, can prepare, sign, seal and engineering plans and drawings to a public authority for approval, or seal engineering work for public and private clients. [39] This requirement may be enshrined in state and provincial statutes, such as in Canadian provinces, such as Ontario or the Quebec Engineers Act. however, virtually all certification bodies maintain a independent of the law, whether they expect all members to comply or risk deportation. [41] More information: FE review, professional engineer, embedded engineer, Washington agreement, and regulation and permits in engineering salaries and labor statistics The total number of engineers employed in the United States in 2015 was approximately 1.6 million. Of these, 278,340 were mechanical engineers (17.28%), the largest discipline by size.[42] In 2012, the median annual income of mechanical engineers in the U.S. workforce was $80,580. The median income was highest when working for the government ($92,030) and lowest in education ($57,090). [43] In 2014, the total number of mechanical engineering jobs is expected to increase by 5% over the next decade. [44] In 2009, the average starting salary was $58,800 with a bachelor's degree. [45] Sub-disciplines The field of mechanical engineering can be considered a collection of many scientific disciplines of mechanical engineering. Many of these sub-disciplines that are usually taught at the undergraduate level are listed below, with a brief explanation and the most common application of each. Some of these sub-disciplines are unique to mechanical engineering, while others are a combination of mechanical engineering and one or more other disciplines. Most of the work a mechanical engineer does uses the skills and techniques of many of these sub-disciplines, as well as specialized sub-disciplines. Specialized sub-disciplines, as used in this article, are more likely to be subject to graduate studies or on-the-job training than undergraduate research. Several specialized sub-disciplines are discussed in this section. Mechanics Circle of Mohr, a common tool to study emphasizes in a mechanical element Main article: Mechanical mechanics is, in the most general sense, the study of forces and their effect on matter. Typically, engineering mechanics are used to analyze and predict the acceleration and deformation (elastics and plastics) of objects under known forces (also called loads) or stresses. The sub-disciplines of mechanics include statics, the study of non-moving bodies under known charges, how forces affect static bodies Dynamics of the study of how forces affect moving bodies. Dynamics include kinetics (on movement, speed and acceleration) and kinetics (about the resulting forces and accelerations). Material mechanics, study of how different materials deform under different types of stress fluid mechanics, study how fluids respond to forces.[46] study of the movement of bodies (objects) and systems (groups of objects), while ignoring the forces that cause movement. Cinematics are often used in the design and analysis of mechanisms. Continuum Mechanics, a method of applying mechanics that assumes that objects are continuous (rather than discrete) Mechanical engineers generally use mechanics in the design or engineering analysis phases. If the engineering project was the design of one of a statics can be used to design the vehicle frame, to assess where the stresses will be most intense. The dynamics can be used when designing the engine of the car, to assess the forces in the pistons and cams that the engine cycles. The mechanics of materials can be used to choose the appropriate materials for the frame and engine. Fluid mechanics can be used to design a ventilation system for the vehicle (see CVC) or to design the engine intake system. Mechatronics and robotics Training FMS with learning robot SCORBOT-ER 4u, workbench CNC Mill and CNC Lathe Main Articles: Mechatronics and Robotics Mechatronics is a combination of mechanics and electronics. It is an interdisciplinary branch of mechanical engineering, electrical engineering and software engineering that is interested in integrating electrical and mechanical engineering to create hybrid systems. In this way, machines can be automated through the use of electric motors, servo-mechanisms, and other electrical systems in conjunction with special software. A common example of a mecatronic system is a CD-ROM player. Mechanical systems open and close the drive, rotate the CD and move the laser, while an optical system reads the data on the CD and converts it into bits. Integrated software controls the process and communicates the contents of the CD to the computer. Robotics is the application of mechatronics to create robots, which are often used in the industry to perform dangerous, unpleasant or repetitive tasks. These robots can be of any shape and size, but all are pre-programmed and physically interact with the world. To create a robot, an engineer usually uses kinematics (to determine the extent of the robot's movement) and mechanics (to determine stresses within the robot). Robots are widely used in industrial engineering. They save businesses money on work, perform tasks that are too dangerous or too specific for humans to perform economically, and ensure better quality. Many companies employ robot assembly lines, especially in the automotive industries, and some factories are so robotic that they can operate on their own. Outside the plant, robots have been used in bomb disposal, space exploration and many other areas. Robots are also sold for a variety of residential applications, from leisure to home applications. Structural Analysis Key Articles: Structural Analysis and Failure Analysis Structural analysis is the branch of mechanical engineering (and also civil engineering) devoted to examining the reasons and how objects fail and correct objects and their performance. Structural failures occur in two general modes: static failure and fatigue failure. A static structural failure occurs when, after being charged (with applied force), the object analyzed breaks or is plastically deformed, depending on the failure criterion. Fatigue failure occurs when an object breaks down after a number of repeated loads unloading cycles. Fatigue failure occurs due to imperfections in the object: a microscopic crack on the surface of the object, for example, will develop slightly with each cycle (spread) until the crack is large enough to cause final failure. [47] Failure is not simply defined as when a coin breaks, however; it is defined as when a room does not work as intended. Some systems, such as the perforated upper sections of some plastic bags, are designed to break. If these systems do not break, a failure analysis can be used to determine the cause. Structural analysis is often used by mechanical engineers after a failure has occurred, or during design to prevent failure. Engineers often use documents and online books such as those published by ASM[48] to help them determine the type of failure and possible causes. Once the theory is applied to a mechanical design, physical tests are often performed to verify the calculated results. Structural analysis can be used in an office when designing parts, in the field to analyze broken parts, or in laboratories where parts can undergo controlled failure tests. Thermodynamics and thermo-science Main article: Thermodynamics Thermodynamics is an applied science used in several branches of engineering, including mechanical and chemical engineering. At its simplest, thermodynamics is the study of energy, its use and transformation through a system. [49] Typically, engineering thermodynamics is concerned with changing energy from one form to another. For example, automotive engines convert the chemical energy (enthalpy) of the fuel into heat and then into mechanical work that eventually transforms the wheels. The principles of thermodynamics are used by mechanical engineers in the fields of heat transfer, thermofluids and energy conversion. Mechanical engineers use thermo-science to design engines and power plants, heating, ventilation and air conditioning (CVC), heat exchangers, heat wells, radiators, refrigeration, insulation, and others. [50] Designing and writing A CAD model of a double mechanical seal Main articles: Technical drawing and cnc writing or technical drawing is the means by which mechanical engineers design products and create instructions for the manufacture of parts. A technical drawing can be a computer model or hand-drawn diagram showing all the dimensions needed to make a part, as well as assembly notes, a list of required materials and other Relevant. [51] An American mechanical engineer or skilled worker who creates technical drawings may be called an editor or draughtsman. Writing has always been a two-dimensional process, but computer-aided design programs now allow the designer to create in three dimensions. Instructions for the manufacture of a part must be given to the necessary machines, either manually, through programmed instructions, or through the use of a computer-aided manufacturing (CAM) program or a combined CAD/CAM program. As an option, an engineer also manually make a part using technical drawings. However, with the advent of computer-controlled (CNC) digital manufacturing, parts can now be manufactured without the need for constant technician input. Manually manufactured parts typically consist of spray coatings, surface finishes and other processes that cannot be manufactured economically or practically by a machine. Writing is used in almost all mechanical engineering sub-disciplines, and by many other branches of engineering and architecture. Three-dimensional models created using CAD software are also commonly used in finite element analysis (FEA) and computational fluid dynamics (CFD). Modern Tools An oblique view of a four-cylinder online crank with pistons Many mechanical engineering companies, particularly those in industrialized countries, have begun to integrate computer-aided engineering (CAE) programs into their existing design and analysis processes, including solid 2D and 3D computer-aided modeling (CAO) design. This method has many advantages, including easier and more comprehensive visualization of products, the ability to create virtual parts assemblies, and ease of use in the design of mating interfaces and tolerances. Other cae programs commonly used by mechanical engineers include product lifecycle management (PLM) tools and analytical tools used to perform complex simulations. Analysis tools can be used to predict the product's response to expected loads, including fatigue life and manufacturability. These tools include finite element analysis (FEA), computational fluid dynamics (CFD) and computer-aided manufacturing (CAM). Using CAE programs, a mechanical design team can quickly and cheaply iterate the design process to develop a product that better responds to costs, performance and other constraints. No physical prototype needs to be created until the design is completed, allowing the evaluation of hundreds or thousands of designs, instead of a relatively small number. In addition, CAE analysis programs can model complex physical phenomena that cannot be solved by hand, such as viscoelasticity, complex contact between mating parts, or non-Newtonian flows. As mechanical engineering begins to merge with other disciplines, as seen in mecatronics, multidisciplinary design optimization (MDO) is used with other CAE programs to automate and improve the design process. MDO tools wrap around existing CAE processes, allowing product evaluation to continue even after the analyst returns home for the day. They also use sophisticated optimization algorithms to more intelligently explore possible designs, often finding better innovative solutions to difficult multidisciplinary design problems. Research Areas Mechanical engineers are constantly pushing the boundaries of what is physically possible to produce safer, cheaper and more efficient machines and mechanical systems. Some state-of-the-art mechanical engineering technologies are listed below exploratory engineering). Micro-electromechanical systems (MEMS) Micron-scale mechanical components such as springs, gears, fluid and heat transfer devices are made from a variety of substrate materials such as silicon, glass and polymers such as SU8. Examples of MEMS components are accelerometers that are used as car airbag sensors, modern cell phones, gyroscopes for precise positioning and microfluidic devices used in biomedical applications. Friction Welding (FSW) Main article: Friction welding Friction stir welding, a new type of welding, was discovered in 1991 by the Welding Institute (TWI). The innovative stable (non-melting) welding technique combines previously undying materials, including several aluminum alloys. It plays an important role in the future construction of aircraft, potentially replacing rivets. Current uses of this technology to date include welding the seams of the main outer tank of the space shuttle in aluminum, orion crew vehicle, Expendable Boeing Delta II and Delta IV launch vehicles and SpaceX's Falcon 1 rocket, armor veneer for amphibious assault ships and welding of the wings and fuselage panels of Eclipse Aviation's new Eclipse 500 aircraft among an ever-expanding pool of uses. [52] [53] [54] Composites Composites Composite Fabric composed of woven carbon fiber Main article: Composite material Composites or composite materials are a combination of materials that provide different physical characteristics of either material separately. Research on composite materials within mechanical engineering generally focuses on the design (and subsequently the search for applications for) stronger or more rigid materials while trying to reduce weight, susceptibility to corrosion and other undesirable factors. Carbon-reinforced carbon fibre composites, for example, have been used in applications as diverse as spacecraft and fishing rods. Mechatronics Mechatronics is the synergistic combination of mechanical engineering, electronic engineering and software engineering. The discipline of mechatronics began as a way to combine mechanical principles with electrical engineering. Mecatronic concepts are used in most electromechanical systems. Typical electromechanical sensors used in mecatronics are stress gauges, thermocouples and pressure transducers. Nanotechnology Main Article: Nanotechnology At the smallest scales, mechanical engineering becomes nanotechnology, one of whose speculative objectives is to create a molecular assembler for molecules and materials by mechanosynthesis. For now, this objective remains in exploratory engineering. Current areas of mechanical engineering research in nanotechnology include nanofilters,[56] nanofilms,[57] and nanostructures,[58] among others. See also: Picotechnology Finite element analysis Main article: Analysis of finite elements Analysis of finite elements is a computational tool used to estimate stress, tension and deviation from solid bodies. It uses a configuration with user-defined sizes to measure physical amounts at a node. The more knots there are, the higher the accuracy. [59] This area is not new, as the basis for the analysis of the finished elements (FEA) or the finite element method (EMF) dates back to 1941. But the evolution of computers has made the FEA/EMF a viable option for the analysis of structural problems. Many business codes such as NASTRAN, ANSYS and ABAQUS are widely used in the industry for research and component design. Some 3D and CAD modeling software have added FEA modules. Lately, cloud simulation platforms like SimScale are becoming more and more common. Other techniques such as the Finite Difference Method (FDM) and the Finished Volume Method (FVM) are used to solve problems related to heat and mass transfer, fluid flow, fluid surface interaction, etc. Biomechanics Main Article: Biomechanics Biomechanics is the application of mechanical principles to biological systems, such as humans, animals, plants, organs and cells. [60] Biomechanics also helps to create prosthetic limbs and artificial organs for humans. Biomechanics is closely linked to engineering, often using traditional technical sciences to analyze biological systems. Some simple applications of Newtonian mechanics and/or materials science can provide correct approximations to the mechanics of many biological systems. Over the past decade, reverse engineering of materials found in nature, such as bone matter, has gained funding in academia. The structure of the bone material is optimized in order to withstand a large amount of compressive stress per unit of weight. [61] The goal is to replace raw steel with material biomaterials for structural design. Over the past decade, the Finished Elements (EMF) method has also entered the biomedical sector, highlighting other technical aspects of biomechanics. Fem has since established itself as an alternative to in vivo surgical evaluation and has gained wide acceptance from academia. The main advantage of computational biomechanics is its ability to determine the endo-anatomical response of an anatomy, without being subject to ethical restrictions. [62] This has led FE modeling to the point of becoming ubiquitous in several areas of biomechanics while several projects have even adopted an open source philosophy (e.g. BioSpine). Computational Fluid Dynamics Main Article: Computational Fluid Dynamics Computational Fluid Dynamics, generally abbreviated as CFD, is a branch of the fluids that use numerical methods and algorithms to solve and analyze problems that involve fluid flows. Computers are used to perform the calculations necessary to simulate the interaction of liquids and gases with surfaces defined by the limit conditions. [63] With high-speed supercomputers, better solutions can be obtained. Ongoing research produces software that improves the accuracy and speed of complex simulation scenarios such as turbulent flows. The initial validation of this software is carried out a wind tunnel whose final validation is to come in the case of large-scale tests, such as flight tests. Acoustic Engineering Main Article: Acoustic Engineering Acoustic engineering is one of the many other sub-disciplines of mechanical engineering and is the application of acoustics. Acoustic engineering is the study of sound and vibration. These engineers work effectively to reduce noise pollution in mechanical appliances and in soundproofing buildings or by removing sources of unwanted noise. The study of acoustics can range from designing a more efficient hearing aid, microphone, headphones, or recording studio to improving the sound quality of an orchestra room. Acoustic engineering also deals with the vibration of different mechanical systems. [64] Related fields Manufacturing engineering, aerospace engineering and automotive engineering are sometimes grouped with mechanical engineering. A bachelor's degree in these fields will usually have a difference of a few specialized classes. See also Engineering Portal At Wikiversity, you can learn more and teach others about mechanical engineering at the Department of Mechanical Engineering Glossary Lists of Historical Monuments of Mechanical Engineering List of Mechanical Engineering Subjects List of Mechanical Engineers List of Related Journals List of Mechanical Equipment Manufacturing Companies, american Society of Mechanical Engineers (ASME) Pi Tau Sigma (Mechanical Engineering honor society) Society of Automotive Engineers (SAE) Society of Women Engineers (SWE) Institution of Mechanical Engineers (IMEE) Chartered Institution of Building Services Engineers (CI)BSE) Verein Deutscher Ingenieure (VDI) (Germany) Wikibooks Engineering Mechanics Engineering Thermodynamics Engineering Acoustics Fluid Mechanics Heat Transfer Microtechnology Nanotechnology Pro/Engineer (ProE CAD) Strength of Materials/Solid Mechanics References - What is mechanical engineering? . Engineering mechanical engineering. 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Machine Manual (30th ed.). New York: Industrial Press Inc. ISBN 978-0-8311-3091-6. Wikimedia Commons external links has media related to mechanical engineering. Mechanical Engineering Quotes at Wikiquote Excerpt from

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