List of engineering branches

Engineering is the discipline and profession that applies scientific theories, mathematical methods, and empirical evidence to design, create, and analyze technological solutions cognizant of safety, human factors, physical laws, regulations, practicality, and cost. In the contemporary era, engineering is generally considered to consist of the major primary branches of chemical engineering, civil engineering, electrical engineering, and mechanical engineering.[1] There are numerous other engineering subdisciplines and interdisciplinary subjects that may or may not be part of these major engineering branches.

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Chemical engineering

Chemical engineering is the application of chemical, physical and biological sciences to the process of converting raw materials or chemicals into more useful or valuable forms.

Subdiscipline	Scope	Major specialties
Biomolecular engineering	Focuses on the manufacturing of biomolecules.	▪ Genetic engineering (of whole genes and their chromosomes) ▪ Immunology and biomolecular/biochemical engineering ▪ Engineering of DNA and RNA (related to genetic engineering)
Materials engineering	Involves properties of matter (material) and its applications to engineering.	▪ Metallurgical engineering, works with metals ▪ Ceramic engineering works with raw oxide materials (e.g. alumina oxide) and advanced materials that are polymorphic, polycrystalline, oxide and non-oxide ceramics ▪ Polymer engineering works with polymer materials ▪ Crystal engineering works with the design and synthesis of molecular solid-state structures ▪ Biomaterials engineering works with natural and living systems
Molecular engineering	Focuses on the manufacturing of molecules.	
Process engineering	Focuses on the design, operation, control and optimization of chemical processes. These include natural and man-made materials, interaction of materials with machines, safety and health, energy conservation and waste and pollution control. This extends to plant design and layout, machine and wet process design and improvement and designing and creating products.	▪ Petroleum refinery engineering works on the manufacture of refined products ▪ Plastics engineering works on the plastics products ▪ Paper engineering works on paper products ▪ Textile engineering works on fiber, textile and apparel products.
Corrosion engineering	Applies scientific knowledge, natural laws and physical resources in order to design and implement materials, structures, devices, systems and procedures to manage corrosion. Generally related to metallurgy, corrosion engineering also encompasses non-metallics including ceramics. Corrosion engineers often manage other not-strictly-corrosion processes including cracking, brittle fracture, crazing, fretting, erosion and more.	

Civil engineering

Civil engineering comprises the design, construction and maintenance of the physical and natural built environments.

Subdiscipline	Scope	Major specialties
Environmental engineering	The application of engineering to the improvement and protection of the environment.	▪ Ecological engineering the design, monitoring and construction of ecosystems ▪ Fire protection engineering the application of engineering to protect people and environments from fire and smoke ▪ Sanitary engineering the application of engineering methods to improve sanitation of human communities ▪ Wastewater engineering Wastewater engineering is a type of engineering that comes from civil engineering and environmental engineering. A wastewater engineer determines the best way to transport or collect rainwater for human populations. Wastewater engineering also deals with the transportation and cleaning of blackwater, greywater and irrigation water. Wastewater treatment and water reclamation are areas of concern in this field. Wastewater engineers map out topographical and geographical features of Earth to determine the best means of collection. They use sonar scanning in wells to determine volumes of water that can be used for human consumption. Using these types of data they are able to provide a means of collecting water After collecting the water, it is their job to transport it to where it can be made available for use. ▪ Municipal or urban engineering civil engineering applied to municipal issues such as water and waste management, transportation networks, subdivisions, communications, hydrology hydraulics, etc.
Geotechnical engineering	Concerned with the behavior of earth materials at the site of a civil engineering project.	▪ Mining engineering the exploration, extraction and processing of raw materials from the Earth ▪ Foundation (engineering) the engineering of below-ground foundations that support superstructures
Structural engineering	The engineering of structures that support or resist structural loads.	▪ Earthquake engineering the behavior of structures subject to seismic loading ▪ Wind engineering the analysis of wind and its effects on the built environment ▪ Architectural engineering application of engineering principles to building design and construction ▪ Ocean engineering the design of offshore structures
Mining engineering	An engineering discipline that involves the science, technology and practice of extracting and processing minerals from a naturally occurring environment. Mining engineering is closely related to many other disciplines like mineral processing and metallurgy geotechnical engineering and surveying. A mining engineer manages all phases of mining operations – from exploration and discovery of the mineral resource, through feasibility studies, mine design, development of plans, production and operations, to mine closure.	

	With the process of mineral extraction some amount of waste material and other byproducts are generated which are the primary source of pollution in the vicinity of mines. Mining activities by their nature cause a disturbance of the natural environment in and around which the minerals are located. Mining engineers must therefore be concerned not only with the production and processing of mineral commodities, but also with the mitigation of damage to the environment both during and after mining as a result of the change in the mining area.	
Transport engineering	The use of engineering to ensure safe and efficient transportation of people and goods.	▪ Traffic engineering, a branch of transportation engineering focusing on the infrastructure necessary for transportation ▪ Highway engineering a branch of engineering that deals with major roadways and transportation systems involving automobiles. Highway engineering usually involves the construction and design of highways. ▪ Railway systems engineering
Utility Engineering	A branch of Civil Engineering that focuses on the planning, design, construction, operation, maintenance, and asset management of any and all utility systems, as well as the interaction between utility infrastructure and other civil infrastructure[2]	▪ Subsurface Utility Engineering(SUE), a branch of utility engineering that involves managing certain risks associated with utility mapping at appropriate quality levels and communication of utility data to concerned parties.
Water resources engineering	Prediction, planning, development and management of water resources.	▪ Hydraulic engineering concerned with the flow and conveyance of fluids, principally water; intimately related to the design of pipelines, water supply network, drainage facilities (including bridges,dams, levees, channels, culverts, storm sewers) and canals. ▪ River engineering, is the process of planned human intervention in the course, characteristics, or flow of a river with the intention of producing some defined benefit—to manage the water resources, to protect against flooding, or to make passage along or across rivers easier. ▪ Coastal engineering the study of the processes ongoing at the shoreline and construction within the coastal zone, often directed at combating erosion of coasts or providing navigational access. ▪ Groundwater engineering involves the analysis, monitoring and often modeling of groundwater source to better understand how much remains and if the water can be used for e.g. recharging reservoirs and irrigation.

Electrical engineering

Electrical engineering comprises the study and application of electricity, electronics and electromagnetism.

Subdiscipline	Scope	Major specialties
Electronic engineering	The creation of physical devices and abstract methods that make it possible to conduct electricity magnetism and light, through low power electrical circuits deemed electronic circuits as well as through communication channels, in such a manner so as to make it possible to control, that is to actuate, on other external entities that can be mechanical, electrical, chemical and even biological in nature, even to the point of automation and thus achieving a manipulation over those natural phenomena so as to concede to them a specific form so that they abstractly represent something, in a processing action that is called program and therefore they become abstract signals of information, which can be subject of further processing and even end-user presentation in what is known as computing.	▪ Control engineering focuses on the modeling of dynamic systems and the design of controllers using electrical circuits, digital signal processors and microcontrollers ▪ Telecommunications engineering, focuses on the transmission and processing of information through communications channels that are created by making use of applied electromagnetism in the physical world and are oftentimes divided in wired and wireless. ▪ Digital electronics systems engineering, covering topics such as microelectronics which is better understood as hardware engineering plus software engineering which in turn covers topics such as embedded systems, digital signal processing, digital image processing, real time operating systems and ultimately computing and as a result, originally computer engineering is a branch of electronics as well.
Computer engineering	The design and control of computing devices with the application of electrical systems.	▪ Software engineering the application of a systematic, disciplined, quantifiable approach to the development, operation and maintenance of software and the study of these approaches; that is, the application of engineering and computer science to software.[3] ▪ Hardware engineering designing, developing and testing various computer equipment. Can range from circuit boards and microprocessors to routers. ▪ Network engineering designing, deploying and maintaining computer networks, such as corporate networks or the Internet.
Power engineering	The generation, transmission and distribution of electricity and the design of devices such as transformers, electric generators, electric motors, high-voltage engineering and power electronics.	
Optical engineering	The design of instruments and systems that utilize the properties of electromagnetic radiation.	

Mechanical engineering

Mechanical engineering comprises the design and analysis of heat and mechanical power for the operation of machines and mechanical systems.

Subdiscipline	Scope	Major specialties
Acoustical engineering	Concerns the manipulation and control of vibration, especially vibration isolation and the reduction of unwanted sounds.	
Manufacturing engineering	Concerns dealing with different manufacturing practices and the research and development of systems, processes, machines, tools and equipment.	
Optomechanical engineering	Field specific to the mechanical aspects of optical systems. Includes design, packaging, mounting and alignment mechanisms specific to optical systems.[4]	▪ Fiber optics ▪ Laser systems ▪ Telescopes ▪ Cameras ▪ Optical instrumentation
Thermal engineering	Concerns heating or cooling of processes, equipment, or enclosed environments.	▪ Air conditioning ▪ Refrigeration ▪ Heating, ventilating
Sports engineering	Is a field of engineering that involves the design, development and testing of sport equipment. The equipment used by athletes has always gone through technological design and development based on current knowledge and understanding.	
Vehicle engineering	The design, manufacture and operation of the systems and equipment that propel and control vehicles.	▪ Automotive engineering bicycles, motorcycles, automobiles, buses and trucks and new telecommunication vehicles ▪ Naval architecture, marine vehicles and structures ▪ Aerospace engineering airplanes, helicopters, drones and spacecraft ▪ Marine engineering, boats, ships, oil rigs and other marine vessels or structures, oceanographic engineering
Power plant engineering	Field of engineering that designs, construct and maintains different types of power plants. Serves as the prime mover to produce electricity.	▪ Geothermal power plants ▪ Coal-fired power plants ▪ Hydroelectric power plants ▪ Diesel engine (ICE) power plants ▪ Tidal power plants ▪ Wind turbine power plants ▪ Solar power plants
Energy engineering	Energy efficiency, energy services, facility management, plant engineering, environmental compliance and energy production. Energy efficiency of buildings and manufacturing processes, employing advances in lighting, insulation and heating/cooling properties.	

Interdisciplinary

Discipline	Scope	Major specialties
Aerospace engineering	Aerosp ▪ Aeronautics, the design and development of aircraft and air traffic control systems ▪ Astronautics, spacecraft, with an emphasis on spacecraft systems, ground control systems and orbital mechanics	
Agricultural engineering	Farm power and machinery, biological material processes, bioenergy, farm structures and agricultural natural resources.	▪ Aquaculture engineering, cultured aquatic species and their production systems ▪ Biomechanical engineering ▪ Bioprocess engineering, products from biological materials ▪ Biotechnical engineering ▪ Ecological engineering, ecosystems ▪ Food engineering, food processing, food machinery, packaging, ingredient manufacturing, instrumentation and control. ▪ Forest engineering ▪ Health and safety engineering ▪ Natural resources engineering ▪ Machinery systems engineering ▪ Information & electrical systems engineering
Applied engineering	Systems integration, manufacturing and management.[5]	▪ Automation/control systems/mechatronics/robotics ▪ Computer-aided drawing and design (CADD) ▪ Construction ▪ Electronics ▪ General ▪ Graphics ▪ Nanotechnology
Biomedical engineering, Biomedical nanoengineering	Medicine and healthcare, biology, biocompatible prostheses, diagnostic and therapeutic devices ranging from clinical equipment to micro-implants, imaging equipment such as MRIs and EEGs, tissue regeneration and pharmaceuticals. The increased utilization of nanotechnology across the existing areas of this branch has lead the specialization Biomedical nanoengineering	▪ Bioinstrumentation, devices and tools used in the diagnosis and treatment of disease. ▪ Bioinformatics, digital tools to collect and analyze biomedical data, such as DNA ▪ Biomechanics, motion, material deformation, transport of chemical substances across biological membranes and flow inside the body. Artificial heart valves, artificial kidneys and artificial hips. ▪ Biomaterial, materials implanted in the body ▪ Biomedical optics ▪ Biosignal processing, recording and processing

		biological signals for diagnostic and therapeutic purposes, such as cardiac signals, speech recognition and brain activity ▪ Biotechnology, use of living systems to make useful products such as pharmaceuticals and foods ▪ Clinical engineering, hospital-related products, including data management, instruments and monitoriing systems ▪ Medical imaging, MRIs, EEGs, ultrasound, PET ▪ Neural engineering, replacement/restoration of lost sensory and motor abilities, neurorobots, neuro electronics. ▪ Pharmaceutical engineering, pharmaceuticals and pharmaceutical delivery ▪ Rehabilitation engineering, products that aid individuals with physical and other impairments, to improve e.g., mobility, seating and communication ▪ Tissue engineering
Biological engineering		▪ Bioacoustics ▪ Biochemical engineering, processes that involve biological organisms or molecules such as bioreactors ▪ Biosystems engineering ▪ Biomedical engineering, the application of engineering principles and techniques to the medical and biological sciences ▪ Biotechnical engineering ▪ Biomolecular engineering ▪ Bioresource engineering ▪ Bioprocess engineering ▪ Cellular engineering ▪ Genetic engineering, manipulate genes in organisms ▪ Food and biological process engineering ▪ Health and safety engineering ▪ Microbiological engineering ▪ Molecular engineering ▪ Protein engineering, protein synthesis ▪ Systems biology ▪ Synthetic biology
Building services engineering	internal environment and environmental impact of buildings and other structures	▪ Architectural engineering

		▪ Mechanical engineering
		  ▪ Heating, ventilation and air conditioning
		  ▪ Refrigeration
		  ▪ Public health engineering: water services, drainage and plumbing
		▪ Electrical engineering
		▪ Lighting, including artificial and emergency lighting, low voltage systems, containment, distribution, distribution boards and switchgear
		▪ Lightning protection
		▪ Security, video and alarm systems
		▪ Escalators and lifts
		▪ Fire engineering, including fire detection and fire protection
		▪ Building façade engineering
		▪ Energy supply – gas, electricity and renewable sources

Energy engineering	Energy efficiency, energy services, facility management, plant engineering, environmental compliance and energy production. Energy efficiency of buildings and manufacturing processes, employing advances in lighting, insulation and heating/cooling properties.	▪ Solar engineering, photovoltaic systems, solar thermal systems ▪ Wind engineering, wind turbines
Information engineering	Generation, distribution, analysis, and use of information, data and knowledge in systems.	▪ Machine learning ▪ Data science ▪ Artificial intelligence ▪ Control theory ▪ Signal processing ▪ Telecommunications ▪ Image processing ▪ Information theory ▪ Computer vision ▪ Natural language processing ▪ Bioinformatics ▪ Medical image computing ▪ Autonomous robotics ▪ Mobile robotics
Industrial engineering	Logistical and resource management systems	▪ Manufacturing engineering tools, equipment and processes ▪ Component engineering optimal compents to be subsequently assembled into products. ▪ Systems engineering logistics, team coordination, machinery control ▪ Construction engineering buildings and other structures ▪ Safety engineering, safe operation and safe failure

		modes ▪ Reliability engineering product durability
Mechatronics engineering	Mechanical and electrical engineering hybrid	▪ Robotics ▪ Instrumentation engineering ▪ Optomechatronics engineering ▪ Biomechatronics engineering ▪ Avionics, the design of electronics and systems on board an aircraft or spacecraft
Engineering management	Management of engineers and engineering processes	
Military engineering	Military weapons and vehicles, such as artillery and tanks	▪ Combat engineering
Nanoengineering	The introduction of nanotechnology into existing fields of engineering.	▪ Materials nanoengineering creating Nanomaterials ▪ Biomedical nanoengineering creating Nanomedicine (Biosensors, Tissue engineering, Drug delivery, etc.) ▪ Instrumentation engineering creating Nanosensors ▪ Electronic nanoengineering creating Nanoelectronics
Nuclear engineering	Terrestrial and marine nuclear power plants	▪ Medical physics ▪ Nuclear fuel ▪ Radiation protection
Petroleum engineering	Oil and natural gas, including oil refining	▪ Reservoir engineering the flow of fluids in underground reservoirs ▪ Drilling engineering well-drilling and fitting ▪ Production engineering surfacing and refining well fluids
Project engineering	Project engineering includes all parts of the design of manufacturing or processing facilities, either new or modifications to and expansions of existing facilities. A "project" consists of a coordinated series of activities or tasks performed by engineers and designers A small project may be under the direction of a project engineer Large projects are typically under the direction of a project manager or management team.Project tasks typically consist of such things asperforming calculations, writing specifications, preparing bids, reviewing equipment proposals and evaluating or selecting equipment and developing and maintaining various lists (equipment and materials lists) and drawings (electrical, instrument and piping schematics, physical layouts and other drawings used in construction).Some facilities have in house staff to handle small projects, while some major companies have a department that does internal project engineering. Large projects are typically contracted out to project engineering companies. Staffing at engineering companies varies according to the work load and duration of employment may only last until an individual's tasks are completed.	▪ Mechanical engineering ▪ Process engineering ▪ Instrumentation and control engineering ▪ Civil engineering ▪ Structural engineering ▪ Environmental engineering ▪ Electrical engineering

Railway engineering	Railway systems, including wheeled and maglev systems	
Software engineering	Software engineering the application of a systematic, disciplined, quantifiable approach to the development, operation and maintenance of software and the study of these approaches; that is, the application of engineering and computer science to software.	▪ Cryptographic engineering Cryptographic Engineering is the discipline of using cryptography to solve human problems. Cryptography is typically applied when trying to ensure data confidentiality, to authenticate people or devices, or to verify data integrity in risky environments. ▪ Information technology engineering, (ITE) or information engineering methodology (IEM) is a software engineering approach to designing and developing information systems. It can also be considered as the generation, distribution, analysis and use of information in systems. ▪ Teletraffic engineering Telecommunications trafic engineering, teletrafic engineering, or trafic engineering is the application of traffic engineering theory to telecommunications. Teletraffic engineers use their knowledge of statistics including queuing theory, the nature of trafic, their practical models, their measurements and simulations to make predictions and to plan telecommunication networks such as a telephone network or the Internet. These tools and knowledge help provide reliable service at lower cost. ▪ Web engineering focuses on the methodologies, techniques and tools that are the foundation of Web application development and which support their design, development, evolution and evaluation. Web engineering is multidisciplinary and encompasses contributions from diverse areas such as systems analysis and design, software engineering, hypermedia/hypertext engineering, requirements engineering, human-computer interaction, user interface, information technology engineering, information indexing and retrieval, testing, modeling and simulation, project management and graphic design and presentation.

Systems engineering	Systems engineering is an interdisciplinary field of engineering that focuses on how to design and manage complex engineering projects over their life cycles. Issues, such as reliability, logistics and coordination of different teams, evaluation measurement and other disciplines become more difficult when dealing with large or complex projects.	• Systems engineering deals with work-processes, optimization methods and risk management tools. It overlaps technical and human-centered disciplines such as control engineering, industrial engineering, organizational studies and project management. Systems engineering ensures that all likely aspects of a project or system are considered and integrated into a whole.
Textile engineering	Textile engineering courses deal with the application of scientific and engineering principles to the design and control of all aspects of fiber, textile and apparel processes, products and machinery. These include natural and man-made materials, interaction of materials with machines, safety and health, energy conservation and waste and pollution control. Additionally, students are given experience in plant design and layout, machine and wet process design and improvement and designing and creating textile products. Throughout the textile engineering curriculum, students take classes from other engineering and disciplines including: mechanical, chemical, materials and industrial engineering.	• Apparel engineering • Fabric engineering • Industrial & production engineering • Textile engineering management • Textile fashion & design • Textile machinery design & maintenance • Wet process engineering • Yarn engineering

See also

- Outline of engineering
- Railway systems engineering

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