List of engineering branches

Engineering is the discipline, art and profession that applies scientific theory to design, develop and analyze technological solutions. In the contemporary era, engineering is generally considered to consist of the major basic branches of chemical engineering, civil engineering, electrical engineering and mechanical engineering.[1] There are numerous other engineering subdiciplines and interdisciplinary subjects that are derived from concentrations, combinations or extensions of the major engineering branches.

Chemical engineering

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

Subdiscipline	Scope	Major specialties
Materials engineering	Involves the properties of matter and its applications to engineering	• Ceramic engineering, the theory and processing of raw oxide material (e.g. alumina oxide), and advanced material that are polymorphic, polycrystalline, oxide, and non-oxide ceramics • Crystal engineering, the design and synthesis of molecular solid-state structures
Process engineering	Focuses on the design, operation, control, and optimization of chemical processes	• Petroleum refinery engineering, the design of processes related to the manufacture of refined products • Plastics engineering, the design of the production process of plastics products • Paper engineering, the design of the production process of paper products
Molecular engineering	Focuses on the manufacturing of molecules.	

Civil engineering

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

Subdiscipline	Scope	Major specialties
Geotechnical engineering	Concerned with the behaviour of geological materials at the site of a civil engineering project	• Mining engineering, the exploration, extraction and processing of raw materials from the earth
Structural engineering	The engineering of structures that support or resist structural loads	• Earthquake engineering, the behaviour 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
Transportation 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 • Railway systems engineering

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 • Hydraulic engineering, the planning, development and maintenance of water resources and the application of hydrology • Municipal engineering, civil engineering applied to municipal issues such as water and waste management, transportation networks, subdivisions, communications, hydrology, hydraulics, etc.

Electrical engineering

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

Subdiscipline	Scope	Major specialties
Electronic engineering	The design of circuits that use the electromagnetic properties of electrical components such as resistors, capacitors, inductors, diodes and transistors to achieve a particular functionality.	• Control engineering, focuses on the modeling of dynamic systems and the design of controllers using electrical circuits, digital signal processors and microcontrollers • Telecommunications engineering
Computer engineering	The design and control of computing devices with the application of electrical systems	• Software engineering, the development of instructions that control computing devices
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, analysis and usage of heat and mechanical power for the operation of machines and mechanical systems.

Subdiscipline	Scope	Major specialties
Vehicle engineering	The design, manufacture and operation of the systems and equipment that propel and control vehicles	• Automotive engineering, the design, manufacture and operation of motorcycles, automobiles, buses and trucks • Aerospace engineering, the design of aircraft, spacecraft and other air vehicles • Naval engineering, the design, construction, operation and support of marine vehicles
Thermal engineering	Concerns heating or cooling of processes, equipment, or enclosed environments	
Acoustical engineering	Concerns the manipulation and control of vibration, especially vibration isolation and the reduction of unwanted sounds	

Interdisciplinary and specialized fields

Discipline	Scope	Major specialties
Industrial engineering	The design and analysis of logistical and resource systems.	• Manufacturing engineering, the ability to plan the practices of manufacturing, to research and develop the tool, processes, machines and equipment, and to integrate the facilities and systems for producing quality products with optimal expenditure. • Component engineering, the process of assuring the availability of suitable components required to manufacture a product. • Systems engineering, focuses on issues such as logistics, the coordination of different teams, automatic control of machinery for complex engineering projects • Construction engineering, the planning and management of construction projects • Safety engineering, assuring that a life-critical system behaves as needed even when pieces fail • Reliability engineering, optimising asset maintenance to minimise whole of life cost
Applied engineering	The field concerned with the application of management, design, and technical skills for the design and integration of systems, the execution of new product designs, the improvement of manufacturing processes, and the management and direction of physical and/or technical functions of a firm or organization. Applied Engineering degreed programs typically include instruction in basic engineering principles, project management, industrial processes, production and operations management, systems integration and control, quality control, and statistics.[2]	• Automation/Control Systems/Mechatronics/Robotics • Computer-aided Drawing & Design (CADD) • Construction • Electronics • General • Graphics • Manufacturing • Nanotechnology
Biological engineering	The application of engineering principles to the fields of biology and medicine.	• Biomedical engineering, the application of engineering principles and techniques to the medical and biological sciences • Genetic engineering, the design and development of techniques to directly manipulate an organism's genes • Biochemical engineering, the design and construction of unit processes that involve biological organisms or molecules • Tissue engineering • Protein engineering, the development of useful or valuable proteins
Mechatronics	A hybrid of mechanical and electrical engineering, intended to examine the design of automation systems.	• Robotics • Instrumentation engineering • Avionics, the design of electronics and systems on board an aircraft or spacecraft
Nuclear engineering	The application of nuclear processes to engineering	
Agricultural engineering	The application of engineering principles to agricultural fields such as farm power and machinery, biological material process, bioenergy, farm structures, and agricultural natural resources	• Bioprocess engineering, the design and development of equipment and processes for the manufacturing of products from biological materials • Food engineering, concerns food processing, food machinery, packaging, ingredient manufacturing, instrumentation, and control. • Aquaculture engineering, the study of cultured aquatic species and the production systems used in their culture.

Nanoengineering	The practice of engineering on the nanoscale	
Petroleum engineering	The application of engineering principles to drilling for and producing crude oil and natural gas	• Reservoir engineering, the application of scientific principles to study the flow of fluids in underground reservoirs so as to obtain a high economic recovery. • Drilling engineering, the design and application of equipment and techniques to drill wells. • Production engineering, the design and application of equipment and techniques to bring well fluids to the surface and then separate out the various components.
Energy engineering	Energy engineering is a broad field of engineering dealing with energy efficiency, energy services, facility management, plant engineering, environmental compliance and alternative energy technologies. Domain of Energy Engineering expertise combines selective subjects from the fields Chemical, Mechanical and Electrical Engineering. It is an interdisciplinary program which has relativity with electrical, mechanical and chemical engineering	• Solar Engineering, Solar Energy Engineering includes designing and building services based on solar energy, solar energy product development, solar PV systems, Solar Product Manufacturing and Solar Systems Integration. • Wind engineering, Wind engineering analysis effects of wind in the natural and the built environment and studies the possible damage, inconvenience or benefits which may result from wind. In the field of structural engineering it includes strong winds, which may cause discomfort, as well as extreme winds, such as in a tornado, hurricane or heavy storm, which may cause widespread destruction

References

[1] Julie Thompson Klein, Robert Frodeman, Carl Mitcham. *The Oxford Handbook of Interdisciplinarity*. Oxford University Press, 2010. (pp 149 - 150)

[2] **ATMAE Membership Venn Diagram** (http://atmae.org/index.php?option=com_content&view=article&id=227&Itemid=48)

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