## Engineering Areas and Specialties

Although the U.S. Department of Labor lists twenty-five engineering specialties with at least eighty-five different subdivisions, it is important to keep in mind that there are six areas of engineering that form the core of the profession:

* Chemical Engineering
* Civil Engineering
* Electrical Engineering
* Industrial Engineering
* Materials Science Engineering
* Mechanical Engineering

Other engineering areas can either be pursued as a specialty area within one of the above-mentioned engineering disciplines or pursued as a college major at institutions that offer a more in-depth preparation for these tasks. The following engineering fields allow one to specialize in an industry or a particular application of engineering knowledge:

* Aerospace engineering
* Agricultural engineering
* Automotive Engineering
* Biomedical Engineering
* Computer Engineering
* Environmental Engineering
* Manufacturing Engineering
* Petroleum Engineering

### There are major functions common to all branches of engineering.

1. Research. A research engineer looks for new principles and processes by using scientific and mathematical concepts, by experimenting, or by using inductive reasoning.
2. Development. A development engineer takes the results of the research and puts them to use. Creative and intelligent application of new ideas may give the world a working model of a new machine, chemical process, or computer chip.
3. Design. A design engineer chooses the methods and materials necessary to meet technical and performance specifications when a new product is being designed.
4. Construction. A construction engineer prepares the construction site, arranges the materials and organizes personnel and equipment.
5. Production. A production engineer takes care of plant layout and the choosing of equipment with regard to the human and economic factors. He or she selects processes and tools, checks the flow of materials and components, and does testing and inspection.
6. Operation. An operating engineer controls manufacturing and processing plants and machines. He or she determines procedures and supervises the workforce.
7. Management. Engineers in the management area analyze customers’ needs, solve economic problems, and deal in a variety of other areas depending on the type of organization involved.

## Five Primary Career Path Scenarios

**Electrical Engineers** are trained in the practical applications of electricity. Electrical engineers focus on the study of behavior of electrical devices and circuits. Main branches of Electrical Engineering are power, telecommunications, electronics, computers, electro-magnetics, electro-optics, digital signal processing, and control systems. Electrical engineers work in the areas of research, development, design and maintenance, and application of electrical or electronic equipment. Specialties include power generation, transmission, distribution and application, systems, traffic, plant, acoustical, control systems, radar, fiber optics, computer interfacing, and radio.

There are four well-recognized branches of electrical engineering:

* power (water, fossil fuels, geothermal, solar, nuclear)
* communications (equipment, transmission, systems, traffic, plant engineering, acoustical engineering),
* electronics (computer hardware, telecommunication systems, radio, T.V., biomedical applications, navigational, consumer products)
* control systems (robotics, auto regulators, computer control of industrial processes)

Electrical Engineers have become instrumental in the design and maintenance of electronic computers. They design computer circuits, plan computer layouts, and formulate mathematical models of technical problems that can be solved by computers.

**Civil Engineers** are trained to work in such areas as structural engineering, transportation engineering, environmental engineering, water resources engineering, construction engineering, and geotechnical engineering. They work in specialties like research and development, planning and design, supervision of construction and operation, engineering sales, and management.

Civil engineers design and build the infrastructure; bridges, highways, rail and water systems, etc., that support almost every facet of our lives, meeting challenges of pollution, traffic congestion, drinking water and energy needs, urban development, and community planning.

Civil engineers are involved in the conception, planning, design, construction, and management of projects essential to modern life, ranging from transit systems to offshore structures, such as oil platforms, to space satellites. Most civil engineers work as part of a team that may include other engineers, scientists, contractors, project owners, architects, bankers, lawyers, and government officials.

**Mechanical Engineers** are trained to design, manufacture, and maintain machinery of all kinds. They work in research, consulting, operations, research and development, testing, design, production, distribution, and technical sales. They work in such areas as power generation, energy conversion, machine design, manufacturing and automation, and control of engineering systems.

Mechanical engineers hold a unique position in the engineering field because they not only design, develop, and produce devices for consumers; they also design, develop and produce many of the tools required by other engineers. Mechanical engineering is one of the most exiting engineering fields because it offers breath, flexibility, and individuality. Mechanical engineering is an extremely creative profession. The work done by these engineers varies by function and industry. Some of the specialists that mechanical engineers pursue include applied mechanics, computer-aided design and manufacturing; energy systems; pressure vessels and piping; and heating, refrigeration, and air-conditioning systems.

**Computer Engineers** analyze solutions, design, develop, manufacture, install, and test computer equipment and software, utilizing advanced communications or multimedia equipment. There are three major types of engineers:

* computer hardware engineers,
* computer systems engineers (including both software and network engineers), and
* computer information science engineers.

Computer engineering crosses the boundaries of many engineering disciplines and depends on the talents and services of other engineers in developing and implementing computer systems. This is particularly true in the case of specialized computer systems, such as those designed for agricultural, biomedical, chemical, transportation, or automotive purposes.

**Chemical Engineers** apply principles and technology of chemistry, physics, mechanical and electrical engineering to develop new or improved chemical manufacturing processes and products. They design chemical plant equipment and devise processes for manufacturing drugs, chemicals and products, such as plastics, synthetic rubber, detergents and textiles. They also design, plan layouts, and oversee the workers engaged in construction, controlling and improving equipment for carrying out chemical processes. Chemical Engineers often specialize in a particular operation such as polymerization or oxidation; others specialize in a particular area such as environmental control or specific products such as plastics, rubber, or textile fibers. Other specialties include research, development, design, plant operation, sales and teaching.

Chemical engineers combine the science of chemistry with the discipline of engineering to solve a wide range of technical problems such as finding more efficient ways of producing things such as plastics, synthetic rubber, medications, food, petrochemicals, and artificial organs. The areas in which chemical engineers typically work include research and development, design and construction, operations and production, technical sales, and environmental and waste management.

**Other Engineering Specialties:** Aeronautical and Aerospace Engineering, Aerospace Studies, Applied Science (Engineering), Architectural Engineering, Biomedical Engineering, Ceramics Engineering, Computer Network Engineering, Electrical and Electronic Engineering, Energy Systems Engineering, Engineering Science, Environmental Engineering, Hydraulic Engineering, Industrial Engineering, Management Engineering, Manufacturing Engineering, Materials Science and Engineering, Metallurgical Engineering, Mining Engineering, Nuclear Engineering, Petroleum Engineering, Structural Engineering.

Graduates of engineering programs are qualified to take the engineer-in-training examination. A professional engineering examination may be taken after four years of work experience. All states require both tests for a professional engineering license.

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