Engineering

Engineering

- Engineering is the application of science to the **optimum** conversion of the resources of nature to the uses of humankind.
- The field has been defined by the **Engineers Council for Professional Development**, in the United States, as the creative application of "scientific principles to design or develop **structures, machines, apparatus, or manufacturing processes**, or works utilizing them singly or in combination; or to construct or operate the same with full cognizance of their design; or to **forecast** their behavior under specific operating conditions; all as respects an intended function, economics of operation and safety to life and property."

Engineering

- The words engine and ingenious are derived from the same Latin root, ***ingenerare***, which means "to create." The early English verb engine meant "to contrive." The function of the **scientist** is to know, while that of the **engineer** is to do. Engineering is based principally on physics, chemistry, and mathematics and their extensions into materials science, solid and fluid mechanics, thermodynamics, transfer and rate processes, and systems analysis.
- Unlike the scientist, the engineer is not free to select the problem that interests him; he must solve problems **as they arise**; his solution must satisfy conflicting requirements.

History of Engineering

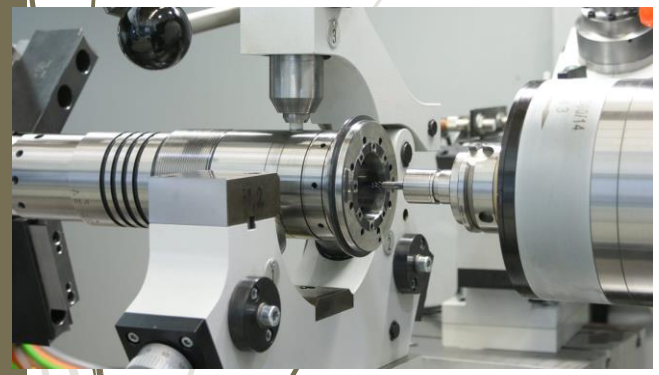
History of Engineering

- The first engineer known by name and achievement is **Imhotep**, builder of the Step Pyramid at Ṣaqqārah, Egypt, probably in about 2550 B.C.
- Engineering remarkable works include: The **Pharos (lighthouse)** of Alexandria, Solomon's Temple in Jerusalem, the Colosseum in Rome, the Persian and Roman road systems, the **Pont du Gard** aqueduct in France, and many other large structures, some of which endure to this day.

History of Engineering

- In construction medieval European engineers carried technique, in the form of the Gothic arch and **flying buttress**, to a height unknown to the Romans.
- **Civil engineering** emerged as a separate discipline in the 18th century, when the first professional societies and schools of engineering were founded.
- Civil engineers built structures of all kinds, designed water-supply and sanitation systems, laid out railroad and highway networks, and planned cities.

History of Engineering



- England and Scotland were the birthplace of **mechanical engineering**, as a derivation of the inventions of the Scottish engineer **James Watt** and the textile machinists of the Industrial Revolution.

- The development of the British **machine-tool** industry gave tremendous impetus to the study of mechanical engineering both in Britain and abroad.

History of Engineering

- The growth of knowledge of electricity from **Alessandro Volta**'s original electric cell of 1800 through the experiments of **Michael Faraday** and others, culminating in 1872 in the Gramme dynamo and electric motor led to the development of **electrical and electronics engineering**.
- The electronics aspect became prominent through the work of such scientists as **James Clerk Maxwell** of Britain and **Heinrich Hertz** of Germany in the late 19th century.

History of Engineering

- **Chemical engineering** grew out of the 19th- century proliferation of industrial processes involving chemical reactions in metallurgy, food, textiles, and many other areas.
- By 1880 the use of chemicals in manufacturing had created an industry whose function was the mass production of chemicals. The design and operation of the plants of this industry became a function of the chemical engineer.

Functions of Engineering

Engineering Functions

- Problem solving is common to all engineering work. The problem may involve quantitative or qualitative factors; it may be physical or economic; it may require abstract mathematics or common sense. Of great importance is the process of creative synthesis or design, putting ideas together to create a new and optimum solution.
- Although engineering problems vary in scope and complexity, the same general approach is applicable. First comes an analysis of the situation and a preliminary decision on a plan of attack. In line with this plan, the problem is reduced to a more categorical question that can be clearly stated. The stated question is then answered by deductive reasoning from known principles or by creative synthesis, as in a new design.

Major Functions of Engineering

- **Research:** Using mathematical and scientific concepts, experimental techniques, and inductive reasoning, the research engineer seeks new principles and processes.
- **Development:** Development engineers apply the results of research to useful purposes. Creative application of new knowledge may result in a working model of a new electrical circuit, a chemical process, or an industrial machine.
- **Design:** In designing a structure or a product, the engineer selects methods, specifies materials, and determines shapes to satisfy technical requirements and to meet performance specifications.
- **Construction:** The construction engineer is responsible for preparing the site, determining procedures that will economically and safely yield the desired quality, directing the placement of materials, and organizing the personnel and equipment.

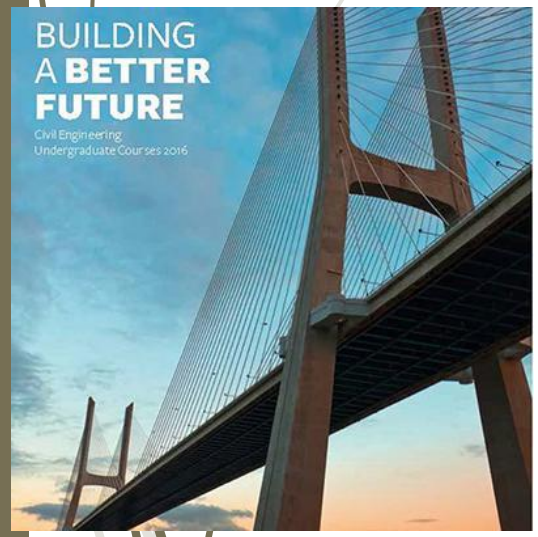
Major Functions of Engineering

- **Production**: Plant layout and equipment selection are the responsibility of the production engineer, who chooses processes and tools, integrates the flow of materials and components, and provides for testing and inspection.
- **Operation:** The operating engineer controls machines, plants, and organizations providing power, transportation, and communication; determines procedures; and supervises personnel to obtain reliable and economic operation of complex equipment.
- **Management and other functions:** In some countries and industries, engineers analyze customers' requirements, recommend units to satisfy needs economically, and resolve related problems.

Fields of Engineering

- **Chemical Engineering**: It consists on the development of processes and the design and operation of plants in which materials undergo changes in their physical or chemical state. Applied throughout the process industries, it is founded on the principles of chemistry, physics, and mathematics.
- Mathematics is a basic tool in optimization and modeling. *Optimization* means arranging materials, facilities, and energy to yield as productive and economical an operation as possible. *Modeling* is the construction of theoretical mathematical prototypes of complex process systems, commonly with the aid of computers. Chemical engineers are employed in the design and development of both processes and plant items. Plant operation and control is increasingly the sphere of the chemical engineer rather than the chemist.

Fields of Engineering



- **Civil Engineering**: It is the profession of designing and executing structural works that serve the general public. The term was first used in the 18th century to distinguish the newly recognized profession from military engineering, until then preeminent.
- The functions of the civil engineer can be divided into three categories: those performed ***before construction*** (feasibility studies, site investigations, and design), those performed ***during construction*** (dealing with clients, consulting engineers, and contractors), and those performed ***after construction*** (maintenance and research).

Fields of Engineering

- **Science and Systems Engineering**: Computer engineering involves many aspects of computer design, the creation of individual components for computer equipment, networking design, and integrating software options with the hardware that will drive the applications. Computer engineers can find work in such fields as telecommunications, transportation, manufacturing, and product development.
- Some of the common tasks associated with the computer engineer include software design that is customized for a particular industry type. A computer engineer is not only part of the design process of a new application, but also continues to provide service and support as new versions of software are released.

Fields of Engineering

- **Electric And Electronics Engineering:** *Electric engineering* is the branch of engineering concerned with the practical applications of electricity in all its forms, including those of the field of electronics.
- *Electronics engineering* is that branch of electrical engineering concerned with the uses of the electromagnetic spectrum and with the application of such electronic devices as integrated circuits, transistors, and vacuum tubes.
- Electrical engineering is the branch dealing with "heavy current" (electric light and power systems and apparatuses) whereas electronics engineering deals with such "light current" applications as wire and radio communication, the stored-program electronic computer, radar, and automatic control systems.

Fields of Engineering

- **Environmental Engineering**: Environmental engineering consists on the development of processes and infrastructure for the supply of water, the disposal of waste, and the control of pollution of all kinds. These endeavors protect public health by preventing disease transmission, and they preserve the quality of the environment by averting the contamination and degradation of air, water, and land resources.
- Projects in environmental engineering involve the treatment and distribution of drinking water; the collection, treatment, and disposal of wastewater; the control of air pollution and noise pollution; municipal solid-waste management and hazardous-waste management; the cleanup of hazardous-waste sites; and the preparation of environmental assessments, audits, and impact studies.

Fields of Engineering

- **Industrial Engineering:** It is the application of engineering principles and techniques of scientific management to the maintenance of a high level of productivity at optimum cost in industrial enterprises. The managers responsible for industrial production require an enormous amount of assistance and support because of the complexity of most production systems, and the additional burden of planning, scheduling, and coordination. Historically, this support was provided by industrial engineers whose major concern was with methods, standards, and the organization of process technology.
- Industrial engineering originated with the studies of Taylor, the Gilbreths, and other pioneers of mass production methods. Their work expanded into responsibilities that now include the development of work methods to increase efficiency and eliminate worker fatigue.

Fields of Engineering

- **Mechanical Engineering:** It is the branch of engineering concerned with the design, manufacture, installation, and operation of engines and machines and with manufacturing processes. It is particularly concerned with forces and motion.
- Four functions of the mechanical engineer can be cited. ***The first*** is the understanding of and dealing with the bases of mechanical science. It include dynamics, concerning the relation between forces and motion. ***Second*** is the sequence of research, design, and development. This function attempts to bring about the changes necessary to meet present and future needs. ***Third*** is production of products and power, which embraces planning, operation, and maintenance. ***Fourth*** is the coordinating function of the mechanical engineer, including management, consulting, and, in some cases, marketing