

# Engineering Disciplines

## Mechanical Engineering/Mechanical Engineering Technology

- Broadest-based discipline in engineering.
- Mechanical engineers are involved in the design, development, production, control, operation and service of machines and mechanical devices.

*Specialty areas include:*

- Design – detailed layout and assembly of the components of machines and devices. Concerned with the strength of parts and the stresses the parts will need to endure.
- Control – mechanical, hydraulic and digital controls.
- Thermal sciences – flow of fluids and the flow of energy between systems.
- Heat transfer – flow of energy due to a temperature difference. They predict and study the temperature of components in environments of operation.
- Engines – design and develop devices that produce mechanical work.
- Power generation systems – steam turbines, boilers, water pumps, condensers, solar and hydroelectric power, alternative fuel engines and fuel cells.
- Heating, ventilation and air-conditioning (HVAC) – climate control of buildings.
- Manufacturing processes – design and develop the machines used in manufacturing processes and develop more efficient processes.
- Robotics – development of robotics and other automated processes.
- Biomedical – develop artificial limbs and joints that provide mobility to physically impaired individuals.
- Packaging – involved with the safe transfer of good to prevent damage.
- See below for further disciplines that mechanical engineers can venture into.

## Civil Engineering

- Civil engineering focuses on structural issues, such as:
  - Bridges and Highways & rapid transit systems
  - Skyscrapers, recreational facilities, houses
  - Industrial Plants and Power Plants
  - Shipping Facilities and Railroad Lines
  - Pipelines, Gas Facilities, Canals, tunnels
- **Structural** engineers are the most common type of civil engineer. They are primarily concerned with the integrity of the structure of building, bridges, dams and highways.
- **Transportation** engineers are concerned with design and construction of highways, railroads, and mass transit systems. Traffic engineering deals with traffic control devices such as signal lights to optimize traffic flow.
- **Surveyors** start the construction process by locating property lines and property areas.
- Also, **urban planning engineers** are involved with a city's infrastructure and **water resource engineers** provide safe and reliable supplies of water for communities.
- See below for further disciplines that civil engineers can venture into.

## Manufacturing Engineering Technology

- Manufacturing engineers work on the development and creation of physical products, production processes, and technology.

- They are responsible for transforming raw materials into finished goods.
- The manufacturing engineering discipline has very strong overlaps with mechanical engineering, industrial engineering, electrical engineering, electronic engineering, computer science, materials management, and operations management.
- Manufacturing engineers have the task of making manufacturing processes better, faster, and cheaper. Their success or failure directly impacts the advancement of technology and the spread of innovation.
- See below for further disciplines that manufacturing engineers can venture into.

***Mechanical, Manufacturing and Civil Engineers can also venture into the following disciplines:***

### **Aerospace Engineering (ME)**

- Aerospace engineering is concerned with engineering applications in the areas of aeronautics (the science of air flight) and astronautics (the science of space flight).
- Aerospace engineering deals with flight of every kind: balloon flight, sailplanes, propeller- and jet- powered aircraft, missiles, rockets, satellites, and advanced interplanetary concepts such as ion-propulsion rockets and solar-wind vehicles.
- **Aerodynamics:** The study of the flow of air over a streamlined surface or body. Concerned with the lift that is produced by a body, resistance or drag forces when a body moves through a fluid. Especially interested in high speed air flows.
- **Propulsion engineers:** develop quieter, more efficient, and cleaner burning engines.
- **Structural engineers:** use of new alloys, composites, and other new materials to meet design requirements of new spacecraft.
- **Control systems:** systems used to operate crafts. Work with electrical engineers.
- **Orbital mechanics:** calculation of where to place satellites that will operate as a communication satellite or as a GPS.
- Aerospace engineers must also be aware of human limitations and the effects of their craft on the human body.

### **Agricultural Engineering (CE & ME)**

- Agricultural engineering focuses on:
  - Soil and water
  - Structures and environment
  - Food engineering
  - Power and machinery
- **Harvesting Equip.** - removes crops from field, and begins processing of food.
- **Structures:** used to hold crops, feed, and livestock; Agricultural engineers develop and design the structures that hold crops.
- **Food process engineers:** concerned with making healthier processed food products.
- **Soil/Water Resources:** Agricultural engineers design and develop ways to address effective land use, proper drainage and erosion control.
- Agricultural engineers work in **bioengineering** to further improve the quality and quantity of agricultural products.
- Agricultural engineers also help in designing information technology systems that meet the needs of rural communities.

### Architectural Engineering (CE & ME)

- **Structural:** primarily concerned with the integrity of the building structure. Evaluates loads placed on buildings, and makes sure the building is structurally sound.
- **Mechanical systems:** control climate of building, as well as humidity and air quality (HVAC).
- **Electrical and lighting** systems to distribute utilities and power throughout the building.
- **Construction engineering and management:** the architectural engineer is responsible for implementing the design in a way which assures the quality of the construction and meets the cost and schedule of the project.

### Biomedical Engineering (ME)

- First recognized in 1940's with the development of wooden legs.
- There are three basic categories: Bioengineering, Medical, and Clinical.
- Bioengineering is application of engineering principles to biological systems – work with geneticists to help mass produce bioengineered products.
- Medical engineers develop instrumentation for medical uses including non-intrusive surgical instruments. They also develop prosthesis and other devices for the physically impaired. Biomedical engineers may also develop chemical processes necessary to make an artificial kidney function or overcome the electrical challenges in designing a new pacemaker.
- Clinical engineers develop systems that help serve the needs of hospitals and clinics such as exhausting anesthetic gases from an operating room or designing special air circulation systems to prevent the spreading of microorganisms throughout the hospital.

### Environmental Engineering (CE)

- Often coupled with Civil Engineering.
- 3 aspects of environmental engineering:
  - **Disposal:** disposing of industrial/residential waste products.
  - **Remediation:** clean up of a contaminated site.
  - **Prevention:** working with corporations to reduce or eliminate harmful waste.

### Industrial Engineering (ME & MFG)

- Industrial engineers design, install, and improve systems that integrate people, materials, and machines to provide efficient production of goods.
- Emphasis placed on: Production, Manufacturing, Human Factors Area, and Operations Research.
- **Production** focuses on plant layout, scheduling, and quality control.
- **Manufacturing** focuses on optimizing manufacturing processes.
- **Human Factors** focuses on the efficient placement of human resources within a plant/facility.
- **Operations Research** is concerned with the optimization of systems.

### **Marine and Ocean Engineering (ME)**

- Concerned with the design, development, and operation of ships and boats.
- **Marine engineer** designs and maintains the systems that operate ships, i.e. propulsion, communication, steering and navigation.
- **Ocean engineer** design and operates marine equipment other than ships, such as submersibles. O.E.s might also work on underwater pipelines and/or cables and drilling platforms.

### **Materials Engineering (ME)**

- Study the structure (molecular bonding and chemical composition), as well as other important properties of materials, i.e. strength, crack growth rates, hardness and durability.
- Design processes and run tests to ensure the quality of the performance of the material – A given material may have very different properties depending on how the material is processed.
- Material Engineers also study metallurgy, ceramics and the development of composites and alloys.

### **Mining Engineering (ME)**

- Work to maintain constant levels of raw minerals used every day in industrial and commercial settings.
- Raw materials must be
  - Discovered – exploration may focus on land areas, the ocean floor, or below the ocean floor.
  - Removed – engineers design and maintain the tunnels and use boring and blasting techniques.
  - Processed and refined – raw minerals must be made into useful forms using chemical and mechanical processes.
- Mining engineers may also become involved in the design of specialized equipment required for the mining industry as well as transportation of minerals to the processing facility.

### **Nuclear Engineering (ME)**

- Mostly concerned with producing and harnessing energy from nuclear sources.
- The production of electricity from nuclear energy is one of the most valuable applications of nuclear engineering. Engineers focus on the design, development and operation of nuclear power facilities. Involves using current fission technology as well as the development of fusion, which would allow sea water to be used as fuel.
- Propulsion systems provide a power source for ships and submarines, allowing them to go years without refueling.
- Drawbacks include radioactive waste which creates opportunities for nuclear engineers to develop a safer and more reliable means to dispose of spent fuel.
- Nuclear engineers also are involved in the use of radiation for medical and agricultural purposes (eliminating harmful bacteria from food).

## Videos:

Aerospace Engineering

<http://www.youtube.com/watch?v=0BIY7zYzNmQ>

Agricultural Engineering

<http://www.youtube.com/watch?v=pygxl0rQ18k>

Biomedical Engineering

[http://www.youtube.com/watch?v=VoedkM\\_y7Og](http://www.youtube.com/watch?v=VoedkM_y7Og)

Civil Engineering

<http://www.youtube.com/watch?v=yGbRqbFkFu8>

Environmental Engineering

<http://www.youtube.com/watch?v=ipxn hao1Ltc>

Industrial Engineering

<http://www.youtube.com/watch?v=9Y5Auwf0nXE>

Marine Engineering

[http://www.youtube.com/watch?v=Wf1eDsH\\_mlc](http://www.youtube.com/watch?v=Wf1eDsH_mlc)

Ocean Engineering

[http://www.youtube.com/watch?v=cXISVf\\_3ShM&feature=PlayList&p=D538D46B3FB7D379&index=0](http://www.youtube.com/watch?v=cXISVf_3ShM&feature=PlayList&p=D538D46B3FB7D379&index=0)

Materials Engineering

<http://www.youtube.com/watch?v=w7yi5KhEZZs&feature=PlayList&p=191BE1E7B8F48668&index=6>

Manufacturing Engineering

[http://www.youtube.com/watch?v=jFLNRfuK5VM&feature=PlayList&p=C43B291E8B8944CB&playnext=1&playnext\\_from=PL&index=10](http://www.youtube.com/watch?v=jFLNRfuK5VM&feature=PlayList&p=C43B291E8B8944CB&playnext=1&playnext_from=PL&index=10)

Mechanical Engineering

<http://www.youtube.com/watch?v=YYAsLxIMEbE>

Mining Engineering

<http://www.youtube.com/watch?v=IRA5fQYtLpw&feature=related>

Nuclear Engineering

<http://www.youtube.com/watch?v=2h8KQq6eWGU>

Petroleum Engineering

<http://www.youtube.com/watch?v=2nJEVIGk9Mc>