Session 3- THE MECHANICAL ENGINEERING AND ITS DIMENSIONS

- 3.1. mechanical engineering vs. other related areas
- 3.2 differences and similarities of industrial engineering vs. other engineering
- 3.3. from expert efficiency to industrial engineer

Engineering Disciplines

1. ***Aerospace engineers***
2. ***Biomedical engineers***
3. ***Chemical engineers***
4. ***Civil engineers***
5. ***Computer hardware engineers***
6. ***Computer software engineers***
7. ***Electrical engineers***
8. ***Electronics engineers, except computer***,
9. ***Environmental engineers***
10. ***Industrial engineers***
11. ***Materials engineers***
12. ***Mechanical engineers***

Aerospace engineers design, test, and supervise the manufacture of aircraft, spacecraft, and missiles.

Those who work with aircraft are called *aeronautical engineers,* and those working specifically with spacecraft are *astronautical engineers*.

Aerospace engineers develop new technologies for use in **aviation, defense systems, and space exploration**, often specializing in areas such as **structural design, guidance, navigation and control, instrumentation and communication, and production methods.**

They also may specialize in a particular type of aerospace product, such as **commercial aircraft, military fighter jets, helicopters, spacecraft, or missiles and rockets**, and may become experts in aerodynamics, thermodynamics, celestial mechanics, propulsion, acoustics, or guidance and control systems.

Biomedical engineers develop devices and procedures that solve medical and health-related problems by combining their knowledge of biology and medicine with engineering principles and practices.

Many do research, along with medical scientists, to develop and evaluate systems and products such as **artificial organs, prostheses** (artificial devices that replace missing body parts), **instrumentation, medical information systems,** and **health management** and **care delivery systems**.

Biomedical engineers also may design devices used in various medical procedures, **imaging systems** such as magnetic resonance imaging (MRI).

Biomedical engineers need a sound background in another engineering specialty, such as mechanical or electronics engineering, in addition to specialized biomedical training.

Chemical engineers apply the principles of chemistry to solve problems involving the production or use of chemicals and other products. **They design equipment and processes for large-scale chemical manufacturing, plan and test methods of manufacturing products and treating byproducts, and supervise production**.

Chemical engineers also work in a variety of manufacturing industries other than chemical manufacturing, such as those **producing energy, electronics, food, clothing, and paper. In addition, they work in healthcare, biotechnology, and business services.**

Chemical engineers may specialize in a particular chemical process, such as **oxidation or polymerization**. Others specialize in a particular field, such as **nanomaterials**, or in the development of specific products.

Civil engineers design and supervise the **construction of roads, buildings, airports, tunnels, dams, bridges, and water supply and sewage systems.**

They must consider many factors in the design process from the **construction costs and expected lifetime of a project to government regulations and potential environmental hazards such as earthquakes and hurricanes.**

Civil engineering, considered one of the oldest engineering disciplines, encompasses many specialties.

The major ones are structural, **water resources, construction, transportation, and geotechnical engineering.**

Many civil engineers hold **supervisory or administrative positions**, from **supervisor of a construction site to city engineer**. Others may work in **design, construction, research, and teaching.**

Computer hardware engineers research, design, develop, test, and oversee the manufacture and installation of **computer hardware, including computer chips, circuit boards, computer systems, and related equipment such as keyboards, routers, and printers.**

The work of computer hardware engineers is similar to that of electronics engineers in that they may design and test circuits and other electronic components; however, computer hardware engineers do that work only as it relates to computers and computer-related equipment.

The rapid advances in computer technology are largely a result of the research, development, and design efforts of these engineers.

Computer software engineers design and develop software. They apply the theories and principles of computer science and mathematical analysis to **create, test, and evaluate the software applications and systems that make computers work**. The tasks performed by these workers evolve quickly, reflecting changes in technology and new areas of specialization, as well as the changing practices of employers.

Software engineers design and develop many types of software, including **computer games, business applications, operating systems, network control systems, and middleware.** They must be experts in

the theory of computing systems, the structure of software, and the nature and limitations of hardware to ensure that the underlying systems will work properly.

Computer software engineers begin by analyzing users' needs, and then design, test, and develop software to meet those needs. During this process they create flowcharts, diagrams, and other documentation, and may also create the detailed sets of instructions, called algorithms, that actually tell the computer what to do.

Electrical engineers design, develop, test, and supervise the manufacture of electrical equipment. Some of this equipment includes **electric motors; machinery controls, lighting, and wiring in buildings; radar and navigation systems; communications systems; and power generation, control, and transmission devices used by electric utilities.**

Electrical engineers also design the electrical systems of automobiles and aircraft. Although the terms *electrical* and *electronics engineering* often are used interchangeably in academia and industry, electrical engineers traditionally have focused on the generation and supply of power, whereas electronics engineers have worked on applications of electricity to control systems or signal processing.

Electrical engineers specialize in areas such as **power systems engineering or electrical equipment manufacturing.**

Electronics engineers, are responsible for a wide range of technologies, from portable music players to global positioning systems (GPS), which can continuously provide the location of, for example, a vehicle.

Electronics engineers design, develop, test, and supervise the manufacture of electronic equipment such as broadcast and communications systems.

Many electronics engineers also work in areas closely related to computers. However, engineers whose work is related exclusively to computer hardware are considered computer hardware engineers.

Electronics engineers specialize in areas such as communications, signal processing, and control systems or have a specialty within one of these areas—control systems or aviation electronics, for example.

Environmental engineers use the principles of biology and chemistry to develop solutions to environmental problems. They are involved in water and air pollution control, recycling, waste disposal, and public health issues.

Environmental engineers conduct hazardous-waste management studies in which they evaluate the significance of the hazard, advise on its treatment and containment, and develop regulations to prevent mishaps.

They design municipal water supply and industrial wastewater treatment systems, conduct research on the environmental impact of proposed construction projects, analyze scientific data, and perform quality-control checks.

Environmental engineers are concerned with local and worldwide environmental issues. Some may study and attempt to minimize the effects of acid rain, global warming, automobile emissions, and ozone depletion. They also may be involved in the protection of wildlife. Many environmental engineers work as consultants, helping their clients to comply with regulations, prevent environmental damage, and clean up hazardous sites.

Industrial engineers determine the **most effective ways to use the basic factors of production—people, machines, materials, information, and energy—to make a product or provide a service.**

They are concerned primarily with **increasing productivity through the management of people, methods of business organization, and technology.**

They develop management control systems to aid in financial planning and cost analysis, and they design production planning and control systems to coordinate activities and ensure product quality.
They also design or improve systems for the physical distribution of goods and services and determine the most efficient plant locations. Industrial engineers develop wage and salary administration systems and job evaluation programs. Many industrial engineers move into management positions because the work is closely related to the work of managers.

Materials engineers are involved in the **development, processing, and testing of the materials** used to create a range of products, from **computer chips and aircraft wings to golf clubs and snow skis.**

They work with **metals, ceramics, plastics, semiconductors, and composites to create new materials** that meet certain mechanical, electrical, and chemical requirements. They also are involved in selecting materials for new applications.

Most materials engineers specialize in a particular material. For example, **metallurgical engineers** specialize in metals such as steel, and **ceramic engineers** develop ceramic materials and the processes for making them into useful products such as glassware or fiber-optic communication lines.

Mechanical engineers **research, design, develop, manufacture, and test tools, engines, machines, and other mechanical devices.**

Mechanical engineering is one of the broadest engineering disciplines. Engineers in this discipline work on **power-producing machines such as electric generators, internal combustion engines, and steam and gas turbines.**

They also work on power-using machines such as **refrigeration and air-conditioning equipment, machine tools, material-handling systems, elevators and escalators, industrial production equipment, and robots used in manufacturing.**

Some mechanical engineers design tools that other engineers need for their work. In addition, mechanical engineers work in **manufacturing or agriculture production, maintenance, or technical sales; many become administrators or managers.**