CHAPTER IV

Aeronautics, Mechanical Engineering, Maritime Engineering and Metallurgy

Aeronautics

Aeronautics

Definition

Science of aerial navigation; technique of constructing flying devices within the Earth's atmosphere[1]

The profession of aeronautical engineer

It allows, in a general sense, the design and testing of high-technology airplanes and helicopters: military aircraft for armed forces or the manufacturing of rockets, space launchers, missiles, and satellites[1].

The term "aeronautical engineer" covers a wide range of profiles and professions: design engineer, calculation engineer, production engineer, flight test engineer, etc. All these professions cover a wide range of fields: electronics, mechanics, aerodynamics, optics, on-board systems, and even marketing: we have to sell the parts and the aircraft once they've been manufactured...

Qualities and skills necessary for the aeronautical engineer?

An aerospace engineer should have:

- A very open mind to envision futuristic projects.
- It is important to speak multiple languages, especially English, as the recruiting companies are often international.
- Curiosity to stay updated on all the latest advancements in new technologies.
- Sharp synthesis skills and a preference for working in groups and delegating certain tasks.
- The ability to make important decisions and handle unforeseen circumstances, particularly regarding budgetary or time constraints[2].

Main professions in the aeronautics sector

- Aeronautical fitter
- Aviation boilermaker
- Design draftsman
- Aeronautical electronics engineer
- Design office engineer
- Design engineer in aeronautical industry
- Aeronautical structural engineer
- Aeronautical cable fitter
- Digital control operator (NC) aeronautics
- Aeronautical painter
- Aeronautical test manager
- Aeronautical stratifier
- Aeronautical Test Technician
- Aircraft maintenance technician
- Aircraft mechanic

Job opportunities

Aeronautical engineers can work[3]:

- in the commercial aviation industry,
- for government and national defense.
- They can also be hired at aircraft manufacturers such as EADS, Dassault Aviation or Eurocopter,
- At engine and equipment manufacturers such as Snecma, Thalès or Sagem.etc...

Mechanical Engineering

The Great Myth

- The most persistent myth about mechanical engineering is its direct association with automotive mechanics
- The word "mechanical" in "mechanical engineering" is not associated with the work of the car mechanic, but with mechanical physics.

A brief history

- The disappearance of the complex craft marks the beginning of large-scale mechanization. This transition takes place in America during the second half of the 19th century.
- It was with the textile industry and rail transport that mechanization took off.
- The discovery of fossil and fissile energy greatly boosted modern mechanization.

Définitions

Mechanics: Mechanics is the science that studies forces and motion for all states of matter (solids, liquids or gases).

- Mechanical engineering refers to the body of knowledge related to mechanics, the physical (sciences of movements) and the technical (study of mechanisms)[4].

Mechanical Engineering Fields:

Mechanical engineering is present in all manufacturing processes and in the design of high-tech products, in all major industrial sectors:

- Production and maintenance of industrial equipment
- Energy production, transport and transformation
- Metal processing
- Aeronautics and aerospace
- Shipbuilding industry
- Military industry
- Automotive industry
- Construction machinery
- Etc...

Mechanical Engineering specialties

The three main specialties offered to Mechanical Engineering engineers can be summarized as follows [5]:

- Mechanical engineering (design - BE)
- Mechanical manufacturing (BM)
- Themal or energy engineering

Mechanical engineering disciplines

Data in the order of the life cycle of a mechanical product.

1. **Product design**
   - Functional analysis, CAD
2. **Mechanics**
   - Study of movements and forces: Dynamics, Kinematics, Statics, Strength of materials.
3. **Mechanical engineering**
   - Dimensioning and calculations of standard elements (Bearings, cylinders, gears, belts ....), Industrial drawing,

4. **Industrialization department**
   - Manufacturing routings, CAM
5. **Production management**
   - CAPM
6. **Production**
   - Production process.
7. **Automation**
8. **Metrology**
9. **Quality**
10. **Maintenance: CMMS.**
11. **Recycling**

Building mechanics:

Calculation of building thermodynamics, home automation, electricity, preparation of plans and specifications, construction supervision, price control, CAD.

Job opportunities

The mechanical engineer is involved in many fields of activity, in SMEs as well as in large groups[5]:

- Industry,
- Transport,
- Aeronautics and aerospace,
- Defense,
- Medical, biomechanical
- Sports equipment and Leisure,
- Machine tools,

- Consumer goods,
- Agri-food,
- Metallurgy,
- Electronic,
- Computer,
- Energy production,
- Telecommunications
- Research & Development

Etc….

Qualifications of the Mechanical Engineer

Mechanical engineers must [6]:

- possess solid scientific, technical and methodological skills.
- Be able to understand industrial activity in its entirety (technical, economic, social and environmental).
- Have a high level of general culture and a broad outlook on the industrial world.
- Fluency in at least one foreign language (English nowadays).
- Able to coordinate and manage teams.
- Must be inquisitive, responsive and flexible, to keep abreast of innovative techniques.

Metallurgy

Definitions

Metallurgy is the materials science that studies metals, their production, properties and treatments [7].

- A set of processes and techniques for the extraction, elaboration, shaping and treatment of metals and their alloys.
- By extension, it is used to designate the metal and alloy manufacturing industry, which is based on the mastery of this science.
- This is a very ancient science.

The 3 specialties of metallurgy

- Production of steel and ferrous alloys (iron and steel industry);
- The production of non-ferrous and non-precious metals;
- Production of precious metals (gold, silver, etc.).

Industrial activities

- The development of the iron and steel industry peaked at the end of the 18th century, paving the way for the Industrial Revolution. Mass production of steel enabled the development of steam engines and internal combustion engines[8].
- Metallurgy covers a wide range of industrial activities:

- ore extraction and 1st transformation (mineralurgy),
- metal recycling; smelting (blast furnaces and refining);
- raw product manufacture by rolling mills;
- transformation of raw materials into semi-finished products;
- manufacture of equipment and finished products for industry, construction and transport.

The role of the metallurgist:

- The metallurgical engineer studies the properties and characteristics of materials and ores and plans, conceptualizes and tests machinery and processes for the treatment of metals, alloys and other materials.
- Above all, the metallurgical engineer must master the physical, chemical and mechanical properties of metals, as well as the characteristics of manufactured products and the techniques used in the company.

Metalworking professions:

Metal forming techniques determine the main sectors of use in the metal industry:

- Foundry (Casting Techniques)
- forging (hot metal work)
- boilermaking (cold metalworking)

Missions of the Metallurgist Engineer

- The metallurgical engineer's mission is to choose or develop high-performance materials, adapted to each production or technical problem. His or her work is therefore very much focused on research, the content and cost of which he or she defines.
- Working with project managers, the metallurgical engineer carries out technical and economic audits to optimize manufacturing processes, solve production problems or improve alloy performance to make them more resistant to wear or corrosion.

Maritime engineering

Role of Maritime Engineering

- Marine Engineering trains engineers with skills that enable them to participate in the design, development and operation of complex systems in marine, underwater and coastal environments[9]:

- Mastery of knowledge of the scientific and technical field of marine engineering,
- Mastery of modeling, simulation, measurement and testing tools for fluids and structures,
- Basic knowledge of mechanics, energy, materials and automation.
- A distinction is made between military and civil marine engineering.

Marine Engineering Sector in Algeria

- In Algeria the Maritime Engineering sector is divided into two specialties. Those of:
  - Naval architecture and navigation
  - The naval equipment engineer.
- Currently the USTO-MB is the only university Algerian who offers training courses academic in this field

Naval Architect

The naval architect is responsible for the design and construction of ships and other marine vessels. His role is [9]:

- To draw up the technical and regulatory plans of the vessel.
- Determine the equipment and materials required to build the vessel.
- Perform resistance calculations, consumption, weight...
- Take charge of the design of the boat until it is launched.

Examples of Naval Architect activities

The naval architect is responsible for carrying out design, construction, modification or repair projects for various types of vessels:

- Pleasure craft ,قوارب النزهة
- Workboats قوارب العمل
- Pontoons, الطوافات
- Yachts, اليخوت
- Fire-fighting vessels, سفن مكافحة الحرائق
- Patrol boats, قوارب الدوريات
- Ferries, العبارات
- Tugs, القاطرات
- Icebreakers, كاسحات الجليد
- Search and rescue vessels, سفن البحث والإنقاذ
- Fishing vessels, coastal, deep-sea fishing vessels, سفن الصيد، سفن الصيد الساحلية وسفن الصيد في أعماق البحار
- Maritime patrol frigates, coastal defense vessels, فرقاطات الدوريات البحرية وسفن الدفاع الساحلي
- Offshore defense vessels, general cargo vessels, bulk carriers, other merchant vessels, barges, drilling rigs or any other fixed or mobile floating structure). سفن الدفاع البحرية، سفن الشحن العامة، سفن نقل البضائع العامة، ناقلات البضائع السائبة، السفن التجارية الأخرى، الصنادل،

Naval equipment engineer

The naval equipment engineer is responsible for designing, developing, producing and testing marine systems[10]:

- Hull systems, أنظمة هياكل السفن
- propulsion systems (diesel engines, gas turbines) أنظمة الدفع (محركات الديزل، التوربينات الغازية)
- Fire-fighting systems, أنظمة مكافحة الحرائق
- Ship machinery, آلات السفينة
- Electrical systems, air distribution systems, electromechanical systems and other related ship equipment. لأنظمة الكهربائية، وأنظمة توزيع الهواء، والأنظمة الكهروميكانيكية وغيرها من معدات السفن ذات الصلة

Marine Engineering courses

- Viscous (incompressible) fluid mechanics ميكانيكا الموائع اللزجة (غير القابلة للانضغاط)
- Hydrodynamics (swell, potential flows, streamlined bodies) الديناميكا المائية (الانتفاخ، التدفقات المحتملة، الأجسام الانسيابية)
- Heat and mass transfer, contaminant dispersion انتقال الحرارة والكتلة، تشتت الملوثات
- Wave-structure interaction, currents, bathymetry, التفاعل بين الموجة والهيكل، التيارات، قياس الأعماق
- Ocean currents (marine flows, Coriolis, Eckman) تيارات المحيطات (التدفقات البحرية، كوريوليس، إيكمان)
- Numerical modeling applied to free-surface flows النمذجة العددية المطبقة على التدفقات السطحية الحرة
- Instrumental techniques (measurement, sensors, metrology, field tests at sea) التقنيات الآلية (القياس، وأجهزة الاستشعار، والمقاييس، والعمل العملي في البحر)
- Materials, physico-chemical properties, corrosion, fatigue المواد، الخواص الفيزيائية والكيميائية، التآكل، الإعياء
- Solid mechanics الميكانيكا الصلبة

Job opportunities

This original training program has numerous national and international outlets in a variety of fields, including[10]:

- Offshore oil and parapetroleum, النفط البحري والبترول البحري
- offshore construction and port engineering, الإنشاءات البحرية وهندسة الموانئ
- marine renewable energies, الطاقات البحرية المتجددة
- coastal protection and onshore structures, الحماية الساحلية والهياكل البرية
- underwater robotics and oceanography. الروبوتات تحت الماء وعلم المحيطات

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