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قســـم العلوم والتقنيات

PROFESSIONS IN SCIENCE AND TECHNOLOGY (MST1)

1st Year Sciences and Technics (ST)

2024/2025

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Course Objective

The course "**Professions in Science and Technology 1"** is designed to introduce students of **1st Year Sciences and Technics** to the vast array of careers available within the fields of science and technology. It aims to provide insights into various professional roles, the educational paths leading to these careers, and the skills required to succeed in them. Through a combination of lectures, guest speakers from industry and academia, and hands-on activities, students will explore many disciplines in engineering science. The course also emphasizes the importance of soft skills like communication, teamwork, and problem-solving in scientific and technological professions. By the end of the course, students should have a clearer understanding of their career options in science and technology and the steps they need to take to pursue their interests.

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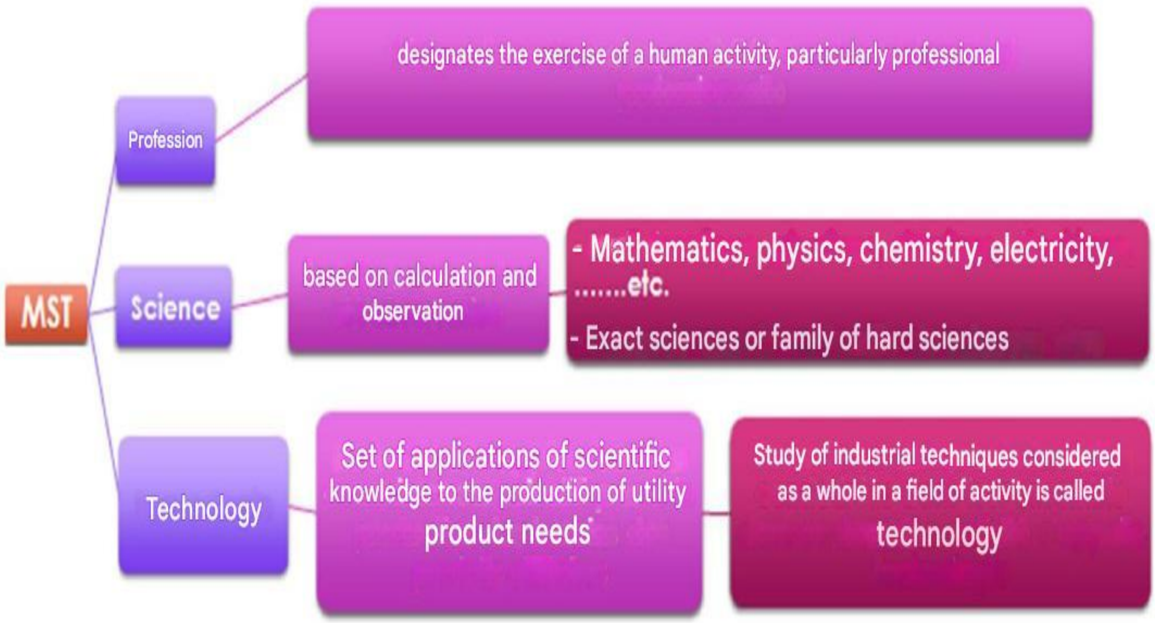
CHAPTER 0

INTRODUCTION

1. Introduction

Science and Technology are omnipresent in our environment, in the objects we use every day, and in all spheres of human activity. The Science and Technology program brings together concepts from different sciences (chemistry, physics, biology, etc.) as well as various fields of technological applications.

2. What is MST?



4. ST Common Core Training

The ST core curriculum manages the common core of specialties in the Science and Technology (ST) field. The core curriculum studies last 4 semesters, consisting of fundamental, methodological, discovery and cross-curricular units. In the 4th semester, the student begins specialty subjects related to their specialty orientation.

The purpose of the core curriculum is to provide basic training common to all specializations. This training thus allows each student to develop the scientific and human qualities required to pursue higher education and to acquire autonomy in their work.

- ***Academic path:*** **LMD**

- ***Below is an overview of open specialties:***

DEPARTEMENT	FILIERE (2ème année Licence)	SPECIALITE(3ème année Licence)
GENIE MECANIQUE	GENIE MECANIQUE	ENERGETIQUE
		GENIE DES MATERIAUX
		Constrution Mécanique
ELECTROMECANIQUE	AUTOMATIQUE	AUTOMATIQUE
	ELECTROMECANIQUE	ELECTROMECANIQUE
	ELECTROTECHNIQUE	ELECTROTECHNIQUE
GENIE DE L'ENVIRONNMENT	GENIE DES PROCEDES	GENIE DES PROCEDES
ELECTRONIQUE	ELECTRONIQUE	ELECTRONIQUE
	TELECOMMINICATIONS	TELECOMMINICATIONS
GENIE CIVIL	GENIE CIVIL	GENIE CIVIL

5. Planning your career

The path to making a decision is relatively simple, but requires you to be informed – about yourself and the various career options out there.

- Determine your sources of motivation
- Learn to know yourself better
- List your skills and know-how
- Establish your professional project
- Adjust your skills and dare to retrain professionally.

❖ **Knowing Yourself**

One of the first steps to choosing a career is knowing who you are and what you love doing most. For example, some people know they would like to work with people, while others know they like to work with their hands or equipment. Basically, it is useful to understand the following about yourself:

❖ **Interests:** This includes the things you like to read and talk about and the things you like to do. People who do what they are interested in are usually happier in their work and are likely to have more job satisfaction.

❖ **Strengths:** What subjects do you perform well in? In which subjects are you weakest? Although performance is not always related to ability, it can sometimes provide some indication of aptitude. Strengths can also include activities outside of the classroom.

❖ **Characteristics and traits:** All people have unique personalities, characteristics and traits. Such qualities could include being calm, patient, competitive, shy, dominating, people oriented, talkative, disciplined, goal-oriented or cautious. Different careers require different characteristics and traits. When careers and personal traits coincide, people generally feel more satisfied.

To understand more, ask yourself the following:

• Do you think with your heart or your head?

• Do you work accurately and check your own work for errors?

• Do you prefer working alone or in a group?

• Do you study consistently hard during the whole year?

• Are you curious and ask lots of questions?

Generally, the qualities most suited to an individual pursuing a Science, Engineering and Technology fields career are:

• The ability to work independently

- A thirst for knowledge and being clever
- Goal orientation and ambition
- The application of logic to thinking and decision-making.

Values: Do you value money above everything else or are you more interested in service to others? These kinds of questions help you to understand your values – those personal beliefs according to which you choose to live your life. These qualities can also affect your choice of career. After you've done some soul-searching about yourself, the next step is to understand all the SET career options available to you.

There are many engineering professions. Generally speaking, an engineer will aim to work on a project or respond to a mission to improve processes or products. The offers for the engineering profession are numerous and in high demand, engineering professions bring together many positions that are very different from each other. Generally, to access this profession, you must complete engineering or technical master's level training. Discover all the jobs you can apply for in the engineering sector.

CHAPTER 1:

What are engineering sciences?

1. Engineering Sciences:

Engineering Sciences, also known as Engineering Science, is a multidisciplinary field that applies scientific principles, mathematics, and engineering techniques to solve complex engineering problems. It serves as the foundation for various engineering disciplines and provides a broad understanding of the fundamental principles that underlie engineering applications. Here are some key aspects of Engineering Sciences:

- **Interdisciplinary Nature:** Engineering Sciences integrate concepts from various scientific and engineering disciplines, such as physics, chemistry, mathematics, biology, and materials science. It seeks to establish a strong theoretical and scientific foundation for engineering practice.

- **Core Concepts**: It encompasses a range of core concepts, including mechanics, thermodynamics, electromagnetism, materials science, fluid dynamics, and control theory. These concepts are essential for understanding the behavior of physical systems and designing solutions.

- **Problem Solving:** Engineering Sciences focus on problem-solving skills and analytical thinking. Engineers in this field analyze and model complex systems, conduct experiments, and use mathematical and computational tools to arrive at solutions.

- **Research and Innovation**: Research in Engineering Sciences often leads to innovative technologies and advancements in engineering fields. It contributes to the development of new materials, processes, and technologies that benefit society.

- **Education**: Engineering Sciences are taught at universities and engineering schools as part of undergraduate and graduate programs. Students study subjects like calculus, physics, chemistry, and engineering mathematics to build a strong foundation.

- **Bridge Between Science and Engineering**: Engineering Sciences serve as a bridge between pure scientific research and engineering applications. They help translate scientific discoveries into practical engineering solutions.

- **Diverse Applications**: The knowledge gained from Engineering Sciences can be applied to a wide range of engineering disciplines, including civil engineering, mechanical engineering, electrical engineering, aerospace engineering, and more.
- **Continual Advancement**: As scientific knowledge advances and technology evolves; Engineering Sciences continually adapt and incorporate new findings into engineering practice.

In summary, Engineering Sciences provide the theoretical framework and scientific understanding that underpin the practice of engineering across various disciplines. Engineers who have a solid grounding in Engineering Sciences are better equipped to tackle complex and novel engineering challenges.

2. Careers in Science and Technology

There are many careers in science and technology, such as:

- ✓ **Engineer:** There are different types of engineers, such as hydraulic engineers, mechanical engineers, electronic engineers, civil engineers, etc. Their role is to design, develop and test products, systems or services
- ✓ **Researcher:** Researchers can work in universities, research institutes or companies. They carry out scientific research in fields such as biology, physics, chemistry, computer science, etc.
- ✓ **Technician:** Technicians are professionals who apply scientific and technical knowledge to maintain and use laboratory equipment and instruments.
- ✓ **Data Analyst:** Data analysts collect, store, manage, analyze data and use statistical tools to extract useful information for businesses and organizations.

- ✓ **Teacher:** Teachers teach science and technology in schools and universities.

These are just a few examples, there are many other professions related to science and technology.

What does it mean to be an engineer?

The engineer?

The very person who is responsible for solving technological problems, concrete and often complex, linked to the design, production and implementation of products, systems or services. Today, behind this term, there is a wide diversity of professions: computer engineer, business engineer, research and development engineers, design engineer, test engineer, sales engineer, materials engineer, design engineer, aeronautical engineer, methods engineer, structural engineer, agronomist engineer...

Why becomes an engineer?

Because it is the main engine of innovation! Its role **consists of designing**, **coordinating and implementing technical solutions** within constraints of time, resources and compliance with regulations.

An engineer must be able to take risks, control, direct, invent, innovate, predict, decide, act and create activity. What is the profession of engineer? All in all, **beyond the necessary scientific skills**, he also has technological, financial, commercial/purchasing, logistical, managerial, legal and social skills. Rigor, organization, precision of reasoning, method are also qualities expected by recruiters, as much as knowledge.

History and challenges of the 21st century:

The volume of knowledge doubles every 5 years. The world is changing and it is changing faster and faster, exponentially. Alongside the destruction of biodiversity, climate change and the widespread pollution of our planet, we must really realize that humanity is also threatened by the depletion of our oil, mineral, aquatic and fishery resources. It is becoming extremely urgent to develop a new vision of our relationship with the Earth because we risk seeing numerous conflicts erupt in the near future over territories, food, water and even oil. More than ever, the world needs real engineers, people who give of themselves and are committed to creating positive change in them, in others and for the Earth. We have entered a very particular period of history filled with challenges that are both unprecedented and colossal while, at the same time, we have at our disposal the tools to transform these perils into opportunities. As a species, the choices we make and the directions we take will be crucial. We must now take matters into our own hands, and Humanity needs a true engineer more than ever.

Who will be the engineers of tomorrow?

Almost all Western countries feel a cruel lack of engineers and fear the disappearance of the "building spirit". Germany, Denmark and the United Kingdom are among the countries which regularly alert their opinion to the risks of the current slope. Developing countries are also worried. In sub-Saharan Africa, UNESCO warned in 2010, 2.5 million new engineers and technicians would be needed to achieve the "millennium goals" regarding access to water and the quality of public hygiene in 2015. . Certainly, China, India and South Korea display triumphant statistics on the progression of their population of graduates, as do certain countries in Central Europe, such as Poland. Second-tier emerging countries, such as Mexico or Turkey, are also starting to catch up. But if we consider the entire planet, the deficit of engineers seems very real.

Where does this deficit come from?

It is firstly part of a lack of attractiveness of all scientific professions, and with them studies perceived as difficult, dry and unpromising in terms of remuneration. This vocations crisis is taking on worrying proportions in developed countries. The European **ROSE** (**Relevance of Science Education**) survey regularly analyzes the interest and motivations of 15-year-olds for scientific and technical careers. However, for several years, we have seen in developed countries a progressive disaffection among younger generations for these professions. The engineering profession is particularly affected. Researchers and politicians put forward different arguments to understand this movement, starting by putting into perspective the historical exception that constituted their extraordinary development in the 20th century, linked to the phases of industrialization which preceded (the United States) and followed (Europe)). The Second World War. The apotheosis of the engineer was that of the building spirit, where the challenge was to build a country: build bridges, highways, industries, launch automobile models, launch rockets, structure and integrate savings. Today the most dynamic phase of this construction has been completed in developed countries, and industry is losing momentum in the face of the development of services, which consume a growing share of scientific graduates. The figure of the builder in the service of national development is fading in favor of other figures, more hedonistic, more mobile and cosmopolitan, more individualistic too, to whom the media make more space. Engineering professions thus suffer from competition from other sectors, such as finance, which also absorb part of the workforce leaving school.

Search for a profession/recruitment by keyword

Writing a relevant application requires first and foremost a good understanding of the job offer. But how to decipher an ad to provide a tailor-made response? Sending an application without having taken the time to dissect the advert is almost like throwing a bottle into the sea: your efforts will be doomed to failure and you will waste precious time. To write a relevant CV and a convincing cover letter, the fruits of an effective application, there are no secrets: you must carry out an in-depth analysis of the advert. But what is the information to identify? And how can you read between the lines of the ad? Anatomy of a job offer.

3. Search for a job

I can't directly assist you in searching for a job, but I can offer some guidance on how to approach a job search:

1. **Identify Your Goals**: Determine the type of job you're looking for, including the industry, location, and your specific skills and qualifications.
2. **Prepare Your Resume/CV**: Update your resume or CV to reflect your most recent experiences and achievements. Tailor it to the specific job you're applying for.
3. **Use Online Job Boards**: Explore popular job search websites like Indeed, LinkedIn, Glassdoor, Monster, and CareerBuilder. These platforms allow you to search for jobs by keyword, location,

and other filters.

4. **Company Websites**: Visit the career pages of companies you're interested in working for. Many employers post job openings directly on their websites.
5. **Networking**: Leverage your professional network. Inform friends, family, and colleagues about your job search, and consider using LinkedIn to connect with professionals in your field.
6. **Recruitment Agencies**: Some industries rely on recruitment agencies to fill job positions. You can reach out to these agencies that specialize in your field.
7. **Professional Associations**: If you're part of a professional association related to your field, they may have job boards or resources to help you in your search.
8. **Create an Online Presence**: Ensure your LinkedIn profile is complete and professional. It can serve as an online resume and networking tool.
9. **Set Up Job Alerts**: On job search websites, you can set up job alerts based on your criteria. This way, you'll receive notifications when new relevant positions are posted.
10. **Customize Your Applications**: Tailor your job applications for each position. Write a unique cover letter for each application and align your resume with the job requirements.
11. **Prepare for Interviews**: Once you start getting interview requests, be prepared. Research the company, practice answering common interview questions, and have questions ready to ask the interviewer.
12. **Stay Persistent**: Job searching can be a lengthy process, so don't get discouraged. Continue applying and networking while staying patient.

Remember that job searching can be a competitive process, so persistence and preparation are key. Be proactive in reaching out to potential employers and showcasing your skills and qualifications. Good luck with your job search!

4. Economic sectors-Sectors of activity

- A sector of economic activity is the grouping of manufacturing, industry, trade or service enterprises that have the same main activity.

- There are three major economic sectors:
  1. Primary
  2. Secondary
  3. Tertiary
- A branch of activity consists of homogeneous production units.
- The classification by sectors of economic activity should not be confused with professional classifications.

i) Primary sector

1. Agriculture
2. Mining
3. Forestry
4. Fishing

ii) Secondary sector

The secondary sector comprises the activities related to the processing of raw materials from the primary sector.

1. Industry (automobile, armaments, railways, naval, aeronautical, aerospace, mechanical, electronic, electrical, energy, chemical, pharmaceutical, agri-food, wood, paper, textile, energy production, household appliances...),
2. Construction and public works,
3. Habitat,
4. Crafts.

iii) Tertiary sector

1. Health,
2. Education – training,
3. Higher education & scientific research,
4. Justice,
5. Culture,
6. Trade,
7. Finance – insurance,
8. Transport - logistics,
9. Tourism
10. Security – environment,
11. Sports,
12. Water,
13. Other services.

Chapter 02

Electronics, Electrical Engineering, Communication Systems and New Sensor Technologies

2.1 Definitions

2.1.1 Automation

Home automation is the set of electronics, building physics, automation, IT and telecommunications techniques used in buildings and making it possible to centralize the control of the various systems and subsystems of the house and of the company.

2.1.2. Automotive embedded systems

An embedded system is defined as an autonomous electronic and computing system, often in real time, specialized in a specific task. The in-vehicle system works in conjunction with various automotive and external in-car systems to provide entertainment and information to passengers and to the driver. The three main areas of the future are the electric car, the connected car and the automated car. On-board electronics are transversal to all of this. It will play a role in functions as diverse as electric charging management, engine control, vehicle connectivity to its external environment, and even driver assistance systems.

2.1.3. Video surveillance

Video surveillance (or video protection) is a system of cameras and image transmission, placed in a public or private space to monitor it remotely, it is therefore a type of remote surveillance. The general objective of a video surveillance system is to contribute to the security of property and/or people. This contribution can focus on various components, often intertwined: Crime prevention, Security, Road and industrial safety.

2.1.4. Mobile telephony

Mobile telephony is an electronic telecommunications device, normally portable, offering a mobile telephony function and can be used over large distances subject to network coverage.

2.1.5. Optical fiber

An optical fiber is a glass or plastic wire through which the internet passes. Optical fiber allows a faster connection than the traditional copper network. The fiber is a dielectric; it does not present a spark risk. The signal loss in optical fiber is lower than that of copper wire. Optical fiber represents a qualitative medium to offer high speeds to all users of the Internet network.

2.1.6. Scientific instrumentation

A scientific instrument is an instrument used in science, allowing data acquisition, measurement or observation, from nanometric and micrometric scales, to macroscopic scales. Most of the time, these are measuring instruments (spectrometers, multimeters, etc.) or observation instruments (photographs, seismographs, spectroscopes, polarizing microscopes ...).

2.1.7. Medical instrumentation

The term Medical Devices covers a wide range of medical instruments used in the treatment, reduction, diagnosis or prevention of a disease or physical condition.

2.1.8. Giant mirrors

A mirror in optics is a reflective surface. Mirrors, as opposed to so-called “refractive” elements such as diopters and lenses, are called “reflective” elements. The quality of a mirror depends greatly on that of the surface of the support, generally made of glass. This surface is expected to be as uniform and smooth as possible.

2.1.9. Contact lenses

A contact lens, also called a contact lens, is a corrective, cosmetic or therapeutic lens placed on the cornea of the eye. You will be happy to know that there is no fixed age range for wearing contact lenses.

2.1.10. Transport of electrical energy

Electric power transmission is the massive movement of electrical energy from a production site, such as an electrical production plant, to an electrical distribution station. Most transmission lines are three-phase alternating current at high or very high voltage.

2.1.11. Electrical energy distributions

Electric power distribution networks are local networks that allow energy to be transported directly to consumers (loads) via a network of overhead power lines or underground cables. Consumers of electrical energy are either low voltage (LV) or medium voltage (MT). A distribution network is generally organized radially, with each point of connection to the medium voltage network serving a “tree” subdividing several times before reaching the distribution transformers.

2.1.12. Electricity production plants

Electric energy is produced in power plants which have elements essential to the generation of electric current. The production of electricity is ensured by the conversion into electrical energy of primary energy which can be either mechanical, chemical, nuclear, or renewable energies.

2.1.13. Energetic efficiency

The notion of energy efficiency of a system, in physics, is defined by the ratio between the level of useful energy it delivers and that of the energy consumed, necessary for its operation. The search for optimal energy efficiency leads to a major advantage on an economic level, through the gain obtained in terms of operating or usage costs in the long term (lower energy consumption).

2.1.14. Maintenance of industrial equipment

Industrial maintenance is all operations intended to prevent or repair breakdowns that occur on machines. It not only limits breakdowns, but above all prevents possible failures, and this is a great help in saving time and improving the productivity and profitability of a factory. The main types of industrial maintenance are: corrective maintenance, preventive maintenance, and predictive (forecast) maintenance.

2.1.15. Elevators

Elevating device for transporting people in a cabin moving between vertical guides, or slightly inclined vertically. Boat lift ensuring the connection between two reaches of different levels. There are essentially two types of elevator families: cable traction elevators and hydraulic elevators.

2.1.16. Wind power

A wind turbine is an electrical machine used to transform the kinetic energy of the wind into mechanical energy, which is itself converted into electricity when several wind turbines are installed on the same site, we speak of a wind turbine “park” or “farm”.

2.1.17. Solar energy

Solar energy is obtained by the energy of the sun's radiation. More precisely, the principle is to transform the energy carried by the photons in light into electricity or heat. Solar energy is an energy source that is dependent on the sun. Thanks to this energy, it is possible to produce electricity without pollution.

2.2. Application areas

2.2.1. Electronic

Electronics is a branch of applied physics, dealing, among other things, with the shaping and management of electrical signals, making it possible, for example, to transmit or receive information. The adjective “electronic” also designates what is related to the electron.

Preamble

Electronics has penetrated widely in our daily lives:

• laptops,

• equipment of our cars,

• computers,

• media players,

• household appliances…

What is electronics?

- ✓ Electronics is the science of controlling the **movement of electrons**.
- ✓ Electronics is a branch of **applied physics**, dealing, among other things, with the formatting and management of **electrical signals**, for example, for the transmission or reception of information. The adjective "electronic" also refers to what is related to the electron.

2.2.1.1.Materials and Current in Electronics

a. Conductors:

- Conductors are materials that allow the easy flow of electrical current.
- Examples of conductors (e.g., copper, aluminum, and silver).
- Their properties are low resistance and good conductivity.

b. Insulators:

- Insulators are materials that do not allow the flow of electrical current.
- Examples of insulators (e.g., rubber, glass, plastic).
- Their properties are high resistance and poor conductivity.

The excellent conductivity of copper and its alloys explains its large-scale use in the electronics industry. Copper allows electronic installations to operate faster, reduce heat formation and last longer: in short, have ever higher performance.

Electronics is the domain by excellence of "***low currents***" with a level of intensity of the order of the (ma).

2.2.1.2. Electronics professions:

The main route to becoming an electrical engineer is to go through an engineering school and obtain an engineering diploma or master's degree with a specialization in electrical engineering or electrical engineering. The electrical engineer develops and industrializes electronic components. Its job consists of adapting the discoveries of physicists to the industrial sector, in the form of technological advances.

The electronics engineer is responsible for designing new electronic components or materials, or participating in their production. It is the centerpiece in the appearance of new innovations in our daily lives, whether for the general public or professionals. The electronics engineer can occupy very specific positions:

• If working in research, the electronics engineer will be responsible for developing technological innovations while respecting the deadlines and costs imposed.

• In the manufacturing sector, the electronics engineer will be responsible for planning and organizing the work of teams.

• The test engineer will be responsible for creating the prototype and testing it in order to verify that it corresponds to what was planned.

• The business engineer is attached to the sales department. A fine connoisseur of his products and their manufacturing, he designs tailor-made products for his customers, adapted to their needs. He is able to conduct negotiations and develop an argument to sell his products.

The professional fields that represent the electronics professions are in the following areas:

- Audiovisual-multimedia equipment.
- Computer equipment.
- Professional audiovisual equipment.
- Housing comfort equipment (Electrodomestique).
- Household appliances.
- Alarm and security equipment.
- Telecommunications equipment and networks.
- Electronic equipment on board.
- Observation, analysis and measurement instrumentation equipment.

2.2.2. Electrical Engineering

What is Electrical Engineering?

Figure 1: *transportation of electricity*

- The discipline that studies the production, transportation, processing, transformation and use of electric energy.

We can note that, **electrical engineering** is associated with "**high currents**" as opposed to "**weak currents**" which would be the exclusive domain of **electronics.**

2.2.2.1. Application Fields

a) It is extremely extensive and involves a very large number of industrial enterprises, in the areas of:

- The production and transportation of electricity (thermal power plants, nuclear power, solar power, wind energy, electricity transmission networks, processing station…)
- Manufacture of electrical equipment (electric engines, disconnectors, contactors, switches…)

b) Electrical engineering is closely linked to the electronics and automation that it frequently uses, for the control of engines.

Figure 2: *The production of electricity*

2.2.2.2 Electrical engineering professions

The professional fields which represent the electrical engineering professions are the following fields:

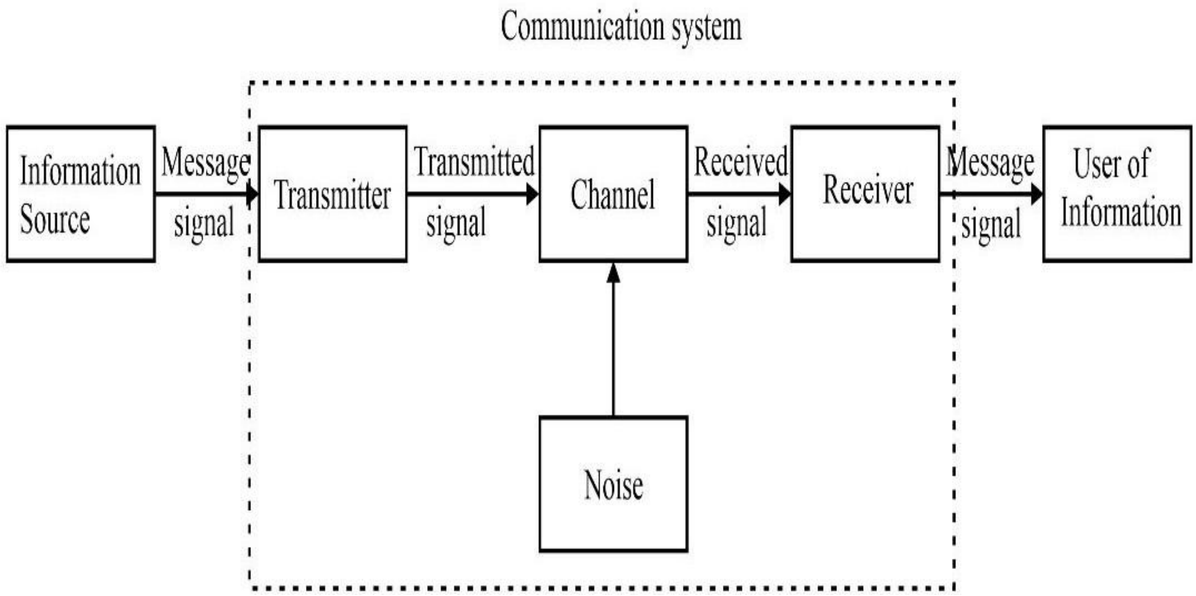
- Electrical machines (electric motors, generators, alternators, converters, etc.);

- Electrical voltage transformers;
- Electrical networks (Base Voltage, Medium Voltage, High Voltage);
- Storage (battery, capacitors);
- Electrical installations and safety equipment (meters, disconnectors, wire cutters, electrical cables, etc.).

2.2.3. Communication systems

Telecommunications is defined as the transmission of information over distance using electronic, computer, wire, optical or electromagnetic transmission technologies. They are thus distinguished from the post office which transmits information or objects in physical form. The function of a communication system is to ensure the transport of information between a transmitter and one (or more) receiver(s) connected by a communication channel or communication medium. This information is transported in the form of a signal.

Examples of communication systems taken outside the Information technology (IT) field are: the telephone, television.



2.2.3.1. What is a communication protocol?

- A protocol is a standard specification that allows communication between two devices. These are rules and procedures that define the type of encoding and speed used during communication, as well as how to establish and terminate the connection.

- There are multitudes of communication protocols, such as VPN (Virtual Private Network) protocols which are designed to create a direct connection between remote computers.

2.2.3.2. Function of the communications system engineer

The communication systems engineer imagines, designs, develops, manages, and secures communication networks that facilitate the exchange of information in the form of signals, images, sounds, and films. Their field of activity is at the intersection of:

- Computer science, mathematics, and telecommunications. Their scope ranges from smart card to remote surgery, through mobile phones, laptops, servers, the Internet, the web and corporate networks, maintenance predictive...

The telecommunications engineer is also called a telecom network engineer, telecoms engineer, telecoms manager or information systems engineer. Are responsible for developing communication techniques by landline, mobile telephone, internet and optical fibers.

The telecommunications engineer designs telecommunications equipment or systems, whether telephone exchanges, software, transmission tools, components or even circuits intended for mobile phones. He will therefore mainly work in large groups linked to telephone networks. However, he can also work as a consultant for engineering consulting companies. The telecommunications engineer can also specialize in the aeronautics or aerospace sector.

2.2.3.3. Career prospects

- Companies or administrations that need to set up and manage a computer network (multinational companies, banks, hospitals),
- Telecommunications companies,
- Research and Teaching,
- Consulting Engineering Offices…etc

CHAPTER 3

Branches of Automation
&
Industrial Engineering

1. Automatic and Automation

Automatic: The term "*automatic*" relates to the field of automation, which is a multidisciplinary science that deals with the modeling, analysis, identification, and control of dynamic systems. In its essence, automation involves the application of mathematical, signal theory, and computer theory foundations to develop control strategies that ensure a system adheres to specified criteria, which could include factors like speed, accuracy, stability …

Automation Professionals: Professionals who specialize in the field of automation are often referred to as "automaticians." These individuals are experts in the theory and practice of designing, implementing, and maintaining automated control systems in various industries.

Automation Objects: Automation allows for the design and creation of specific objects and control mechanisms to carry out the automation of a system. These objects, often referred to as "automations" or "control-control organs," play a crucial role in ensuring that a controlled system operates in a manner consistent with predetermined specifications and requirements. Examples of these objects include automatic control systems and regulators.

In summary, "automatic" and "automation" are closely linked terms that encompass the science of controlling dynamic systems using mathematical and theoretical foundations. Automation professionals, known as "automaticians," are responsible for designing and implementing control mechanisms and objects to ensure that systems meet predefined criteria and function efficiently.

1.1. Professions in Automation and Industrial:

a) Automation Technician or Engineer:

Main mission; The automation engineer is an automation professional in the company. The automation engineer designs and implements complex automated systems. Activity Principal:

➢ Creates the general architecture of a machine or an automated production line.

➢ Follows and manages a technical project.

➢ Carry out programming and commissioning of machines.

Tasks:

- Analyzes the operations to be carried out, in conjunction with the production department.
- Writes the specifications taking into account the needs expressed.
- Defines and designs the architecture of an automated production line.
- Organizes and manages the project while respecting the schedule.
- Leads technical and financial negotiations with suppliers.
- Ensures the programming of PLCs, defines and monitors the tests as well as the start-up of the machines.
- Trains and advises users of automated equipment and services.

These professionals have expertise in the design, installation, programming, and maintenance of automated systems, including robots and programmable controllers. They can work in various sectors, including:

- ***Manufacturing industry:*** Where they are responsible for optimizing production processes and ensuring machinery functions efficiently.
- ***Processing industries:*** Such as chemical, petrochemical, or food processing, where they oversee control and instrumentation systems.
- ***Home automation:*** In this field, they focus on creating smart home systems that improve convenience and energy efficiency.
- ***Special machines:*** Automation engineers working on special machines design and integrate automation solutions for custom equipment.

SKILLS:

- Mastery of Computer Aided Manufacturing Design (CAD/CAM) software.
- Masters Computer-Assisted Group Technology (CGAO).
- Uses Integrated Management software packages.
- Provides technical support to quality, maintenance and methods services.

- Ensures compliance with quality standards.
- Organization, project management and planning.
- Managerial qualities
- Sense of listening and service
- Sense of negotiation
- Technology watch.
- Technical mastery of English. Perspectives of evolution
- Project Manager.
- Design office director.
- Production director.
- Industrial production director.

b) Control, Command, and Instrumentation Engineer: In process industries like cement, oil exploration, or chemical manufacturing, professionals in this role are responsible for the control and monitoring of industrial processes. They ensure that systems operate safely and efficiently, using automated control systems and instrumentation.

c) Special Machine Automation Engineer: These automation engineers are versatile and have a broad skill set. They are proficient in mechanical design, software tools like SEE Electrical, Autocad, or Catia, pneumatics, hydraulics, and electrical engineering. Their work involves designing and implementing automation solutions for unique, specialized machines or equipment.

d) Industrial Computing Specialist:

The industrial engineer designs and manages the industrialization of products. The industrial engineer contributes to optimizing the performance of the industrial organization. Main Activity:

➢ Optimizes and validates production processes.

➢ Definition of product manufacturing processes.

Tasks:

• Validates feasibility studies, approval and qualification plans.

• Creates the manufacturing file: choice of procedures, writing of instruction sheets for the production department.

• Participates in the definition of manufacturing processes for new products.

• Arbitrates and allocates means and resources (human, financial, deadlines, materials, etc.).

• Controls the conformity of production processes with the specifications.

• Analyzes production costs, defines cost prices.

The industrial engineering specialty is based in particular on computer engineering and automation, enhanced by human sciences and management. It makes it possible to understand complex technical and human systems in their entirety, to analyze them, model them, simulate them, develop them and optimize them. Industrial engineering as a discipline focuses on examining how to do things better. This engineering discipline concerns: the design and management of processes and systems that improve the quality and productivity of the supply chain of companies. Industrial engineering provides a systematic approach to rationalizing and improving the productivity and efficiency of organizations, whether governmental or private. The term industrial is not limited only to the size of manufacturing or manufacturing workshops. It is recognized that industrial engineers have the technical training to make improvements to a manufacturing system. Automation specialists who focus on industrial computing have in-depth knowledge of industrial networks, fieldbuses, databases, and communication protocols with programmable controllers. They work on integrating and optimizing software and communication systems in industrial settings to improve efficiency and data management.

These professions play a crucial role in a wide range of industries, ensuring that automation and control systems are effectively designed, implemented, and maintained. They contribute to increased productivity, reduced operational costs, and improved safety in various industrial and manufacturing processes. Professionals in these roles often work closely with multidisciplinary teams to achieve automation and IT goals.

SKILLS:

• Performs an internal audit.

• Mastery of Computer Aided Design and Drawing (CAD) software

• Implements a continuous improvement process.

• Manages and manages a budget.

• Mastery of Computer Aided Manufacturing Design (CAD/CAM) software.

• Mastery of computer-assisted maintenance management (CMMS) software.

• Masters work organization methods.

• Masters and integrates problem solving methods and tools.

• Respects quality standards.

• Performs maintenance procedures.

• Complies with Quality, Health, Safety and Environment (QHSE) rules.

• Analyzes production activity data.

• Provides technical support to quality, maintenance and methods departments.

• Directs a service or structure.

• Negotiates a contract.

Perspectives of evolution:

• Production director.

• Project Manager.

• Head of Service.

• Industrial production director.

1.2. Application fields Automatic and industrial engineering

The fields of Automation and Industrial Engineering have a broad range of applications across various industries. Here are some of the key application fields for these disciplines:

- ***Manufacturing Industry:*** Automation and industrial engineering play a central role in manufacturing. They are involved in optimizing production processes, ensuring quality control, and reducing production costs. This includes the automation of assembly lines, robotic welding, CNC machining, and material handling systems.
- ***Process Industries:*** Process industries such as chemical manufacturing, petrochemicals, pharmaceuticals, and food processing heavily rely on automation and industrial engineering. These fields are involved in controlling and monitoring complex chemical processes, ensuring safety, and maintaining consistent product quality.
- ***Energy Production:*** In the energy sector, automation and industrial engineering are crucial for the operation and maintenance of power plants, including fossil fuel, nuclear, and renewable energy facilities. They are responsible for controlling and monitoring energy production processes, optimizing energy distribution, and ensuring safety protocols.
- ***Aerospace and Automotive:*** These industries benefit from automation in manufacturing processes, including the assembly of aircraft and automotive components. Automation also plays a role in quality control and testing of these products.
- ***Robotics:*** Automation engineers are involved in the design, development, and programming of industrial robots used in various industries, including automotive,electronics, and logistics. Robots are used for tasks such as welding, painting, and material handling.
- ***Supply Chain and Logistics:*** Automation and industrial engineering are used to optimize supply chain and logistics operations. This includes the automation of warehouses, sorting and distribution systems, and supply chain management.

- ***Home Automation:*** Home automation integrates technology and automation for residential buildings. It includes smart home systems that control lighting, heating, cooling, security, and entertainment systems, enhancing convenience and energy efficiency.
- ***Healthcare:*** Automation and industrial engineering are applied in healthcare for tasks like automated drug dispensing, robotic surgery, and medical equipment manufacturing. These technologies contribute to improved patient care and increased efficiency in healthcare processes.
- ***Environmental Engineering:*** In the context of environmental engineering, automation is used for environmental monitoring, pollution control, and waste management. It plays a role in ensuring compliance with environmental regulations.
- ***Agriculture:*** Automation is used in precision agriculture for tasks like automated planting, harvesting, and monitoring of crops. It helps increase agricultural efficiency and reduce resource consumption.
- ***Telecommunications:*** Automation and industrial engineering are involved in the management of telecommunications networks and the development of communication systems and devices.
- ***Research and Development:*** Automation and industrial engineering are essential in laboratories and research facilities for automating experiments, data collection, and sample handling.
- ***Smart Cities:*** In the context of smart cities, automation is used to enhance urban living through automated traffic management, waste collection, and energy-efficient infrastructure.

1.3. Job outlook for automation professionals

These application fields showcase the versatility and significance of automation and industrial engineering in modern industries. They contribute to improved efficiency, safety, and resource management in various sectors, ultimately driving economic growth and technological advancement.

The job outlook for automation professionals is highly promising, driven by rapid advancements in technology and increasing adoption of automation across industries. Here are some key trends:

1. **Growing Demand**: The global industrial automation market is projected to grow significantly, with estimates suggesting it could exceed $295 billion by 2028. This growth is fueled by the adoption of technologies like AI, machine learning, and robotics.
2. **Diverse Opportunities**: Roles such as robotic engineers, RPA (Robotic Process Automation) developers, and automation analysts are in high demand. These positions span industries like manufacturing, healthcare, and logistics.
3. **Technological Integration**: The rise of intelligent automation, which combines AI with traditional automation, is creating new opportunities for professionals skilled in integrating these technologies.
4. **Global Trends**: Countries worldwide are experiencing a surge in demand for automation talent. For instance, the U.S. has seen a 40% growth rate in robotic engineering roles.
5. **Future-Proof Careers**: Automation professionals are less likely to face job displacement, as their expertise is critical in designing and managing the very systems that drive automation.

CHAPTER 4

Branches of Process Engineering, Hydrocarbons and Petrochemical Industries

1. Process Engineering

Introduction to Process Engineering

Process engineering is a multidisciplinary field at the heart of industrial and chemical engineering that plays a pivotal role in the design, optimization, and management of industrial processes. It encompasses a wide range of industries, each with its own unique set of challenges and requirements. In this introduction, we will explore the fundamental principles and key concepts that underpin the world of process engineering.

1.1. Defining Process Engineering:

At its core, process engineering is the application of scientific and engineering principles to the creation, modification, and improvement of processes that involve the transformation of raw materials into valuable products or services. These processes can encompass a wide spectrum of industries, from pharmaceuticals and food production to petrochemicals, textiles, and energy. Process engineering endeavors to ensure that these transformations are not only efficient and cost-effective but also environmentally responsible and safe.

*Since the middle of the 19th century, **applied chemistry** and then "industrial chemistry" has been seen as part of all the knowledge that chemists represent as a science.*

a) Historical Perspective:

The roots of process engineering date back to the middle of the 19th century when the principles of applied chemistry and industrial chemistry became integral to scientific and industrial knowledge. It is within this framework that process engineering began to emerge. Over time, it evolved into a distinct discipline with its own unique focus on industrial processes and the technologies that drive them.

Process engineering is a younger discipline. Originally in the US (early 20th century), it was called **chemical engineering**. It is nothing more than chemical engineering whenever it is applied to process industries other than the chemical industry.

- ***Definition of industrial chemistry***

Industrial chemistry is the economic activity that produces molecules and other chemical compounds in large quantities, called industrial, by exploiting chemical engineering technologies. Industrial chemistry therefore appears to be an essential science for all those who want to implement production processes. Since the mid-19th century, applied chemistry and then industrial chemistry has been considered part of the body of knowledge that represents chemistry as a science.

A. Chemical engineering:

Chemical engineering is located at the convergence of several disciplines and studies the transformations, transports and transfers of matter, energy and momentum to establish laws and correlations that can be used during transposition or extrapolation to an industrial scale. And it is also the body of scientific and technical knowledge which aims to design and implement a chemical plant and optimize its production. The task of the chemical engineer is:

- Sizing
- Manufacturing
- Operation

Chemical engineering opportunities:

- Oil industry, particularly refining
- Chemical industries (plastic industry, detergent, cosmetics)
- Pharmaceutical industries
- Food industries (juices, yogurts)
- Electronic industries.

B. Environmental engineering

It predicts and measures the impact of production methods on the environment, and then offers suitable solutions to control air and water pollution and manage waste. It strives to ensure compliance with regulations in force and to avoid ecological disasters (factory explosions, oil sinkings), it also ensures that industrial production is hampered as little

b) Application fields

Process engineering finds application in a diverse array of industries:

1. **Pharmaceutical Industry:** In pharmaceuticals, process engineering plays a pivotal role in ensuring the safe and efficient production of drugs, from initial synthesis to packaging and quality control.
2. **Agro-Food Industry:** Process engineering is crucial in food processing and packaging, with a focus on quality control and food safety standards.
3. **Leather and Textiles Industry:** Process engineers optimize processes in the manufacturing of leather, textiles, and apparel, often taking sustainability and environmental considerations into account.
4. **Biotechnology:** In the biotechnology sector, process engineering is indispensable for the production of biopharmaceuticals and biofuels, with a particular emphasis on quality control and sterile processes.
5. **Chemical and Petrochemical Industry:** Process engineering is a key player in the production of chemicals, plastics, and petrochemicals, with a strong focus on safety and environmental impact.
6. **Plastics Industry:** Process engineers working in the plastics industry are responsible for polymer production, processing, and recycling, considering material properties and sustainability.
7. **Energy Sector (Oil and Gas):** Process engineers in the energy sector are central to the extraction, refining, and distribution of oil and gas, addressing critical energy production challenges and environmental impact.

i) Role of Process Engineering Specialists:

Process engineering specialists are tasked with solving industry-specific challenges. They must be innovative problem solvers, deeply committed to sustainability, and ethically driven. They bridge the gap between laboratory experiments and full-scale industrial processes, ensuring that operations run smoothly, economically, and in compliance with strict quality and safety standards.

As we delve further into the world of process engineering, we will explore the intricacies of various industries and the significant contributions made by process engineers in optimizing our industrial landscape.

5. The role of process specialty

The processes are applied in a wide range of industries, on site:

- Chemical and para-chemical industry (plastic, synthetic textile, synthetic rubber (elastomer), detergent, adhesive, fertilizer)

- Pharmaceutical industries Oil refining and petrochemicals

- Environment: treatment of water, air and waste

- Food industry and bio-industries

- Quality and safety in processes

- Management of industrial processes

2. Mining Engineering

Introduction

Mining engineering is a specialized field of engineering that deals with the exploration, extraction, and processing of valuable minerals and resources from the Earth.

A mine is a reservoir of materials (e.g. gold, coal, copper, diamonds, iron, salt, uranium, etc.).

2.1. Intervention area

In the context of mining engineering, the term "intervention area" can be applied to specific aspects or domains within the field where engineering interventions, research, or activities are focused.

1. **Exploration:** Mining engineers are involved in the initial phase of identifying potential mineral deposits. They use various geological and geophysical techniques to assess the presence and quality of resources.

2. **Mining Operation:** Once a viable deposit is identified, mining engineers plan and execute the extraction process. This involves designing mining methods, selecting appropriate equipment, and ensuring the safety and efficiency of the mining operation. Different methods can be used, such as open-pit mining, underground mining, or placer mining, depending on the nature of the deposit.

3. **Safety and Environmental Considerations:**

Mining engineers are responsible for ensuring that mining operations are conducted safely and in an environmentally responsible manner. They must develop and implement safety protocols, address potential hazards, and minimize the impact on the environment through reclamation and waste management strategies.

4. **Mineral Processing:** After extraction, minerals and ores often require processing to separate valuable components from the waste material. Mining engineers design and oversee mineral processing plants, which can involve crushing, grinding, flotation, smelting, and other techniques to extract and refine the desired minerals.

5. **Materials Handling:** Managing the transportation of mined materials is another critical aspect. This includes designing efficient transportation systems, such as conveyor belts or truck haulage, to move materials from the mine to processing facilities or markets.

6. **Resource Management:** Mining engineers must consider factors like resource estimation, reserve management, and optimizing the recovery of valuable materials. This involves assessing the economic viability of mining projects.

7. **Technological Advancements:** Staying up-to-date with technological advancements is crucial in the mining industry. Mining engineers often work on developing and implementing cutting-edge technologies to improve mining efficiency and sustainability.

8. **Management and Planning:** Effective project management and planning are essential to ensure that mining operations are executed on time and within budget. This includes managing personnel, equipment, and logistics.

9. **Legal and Regulatory Compliance:** Mining engineers must be knowledgeable about and compliant with local, national, and international regulations governing mining operations, safety standards, and environmental protection.

10. **Community and Stakeholder Relations:** Mining operations can have a significant impact on local communities and stakeholders. Mining engineers often work to establish positive relationships with these groups, addressing their concerns and contributing to sustainable development.

11. **Economic and Financial Analysis:** Analyzing the financial aspects of mining projects, including cost estimation, revenue forecasting, and risk assessment, is crucial for decision-making and investment.

Mining engineering plays a vital role in the responsible and sustainable extraction of Earth's resources while considering safety, environmental impact, and economic factors. It is an interdisciplinary field that combines elements of geology, geotechnical engineering, mineral processing, and various other engineering disciplines to meet the demands of the mining industry.

a) Mining Engineering training:

Mining engineering training includes:

1. • Geosciences (geology, geophysics, petrography, geostatistics);
2. • Mathematics, Computer Science;

3. • Rock Mechanics, Geomechanics;
4. • Open and Underground Mining;
5. • Minerals Recovery and Processing,
6. • Field Control and Geo Engineering;
7. • Digital Design and Modelling (Computer Aided Design, CAD, Conception Assistée par Ordinateur,"CAO");
8. • Security, Economics and Business Management;

i) Area of Intervention

The main areas of intervention of the mining engineer are:

- Open-air and underground mining industry,
- Mining development,
- Mine planning, exploitation, and management.

It is also in demand in various sectors of public works and civil engineering such as groundwork, basic infrastructure and works of art (bridges, tunnels, railways, dam...), land control and Geo-Risques.

1 Employment opportunities:

The mining sector offers excellent job prospects both nationally and internationally, with engineers working in the various sectors of mining, civil engineering, public works, public administrations (Ministries, Control Agencies), the private sector, consulting and materials analysis and testing laboratories, and research centers.

3. Hydrocarbons and petrochemical industry:

A hydrocarbon (HC) is an organic compound consisting exclusively of carbon (C) and hydrogen (H) atoms, their crude formula is: $C_n H_m$ where (n and m) are two natural numbers. They can be saturated, called alkanes, or unsaturated (alkenes, alkynes and aromatic compounds). Hydrocarbons are flammable, like oil and natural gas, so they do not mix with water (immiscible).

3.1. The different hydrocarbons

Hydrocarbons are classified according to their nature:

Hydrocarbons	Examples	Sources
Saturated: the carbon chain is made up only of single bonds	**Alkane:** called paraffins. These are composed very little reactive. They don't give each other cold no reaction with chlorine, nor bromine. But their reaction with oxygen, hot or under the action of bright light, releases a large amount of heat with the formation of carbon dioxide and water. The general formula: C_nH_{2n+2}	Their main source is oil. The combustion of alkanes is the main source of energy used. Petroleum is made up largely of alkanes resulting from deposits of organic matter buried at the bottom of the oceans
Unsaturated: the carbon chain has at least one double or triple bond	**Alkene:** hydrocarbon derived from alkanes, containing the C=C double bond and of the general form C_nH_{2n}. an alkene is capable of absorbing hydrogen in the presence of a catalyst at ordinary temperature and pressure, forming a alkane. **Alkyne:** hydrocarbon derived from alkanes, containing a triple C≡C bond and general formula: C_nH_{2n-2}. The triple bond represents the lightest of the family is acetylene (Ethyne).	Not present, or very rarely in oils. On the other hand, they are common in plant or animal biological compounds, but rarely in the form of simple compounds. Although represented in certain natural molecules the triple bond is quite rare. This structure is presented in many original molecules plant or animal. Benzene is mainly

	Aromatic: all aromatic compounds are derived from benzene. Their overall formula C_6H_6	extracted from coal tars or petroleum residues.

❖ ***Where do oil and gas hydrocarbons come from?***

These are assemblies of carbon and hydrogen atoms in greater or lesser quantities for oil and gas. They come from the accumulation of deposits of marine organisms at the bottom of the oceans during tens of millions of years of the formation of the earth, during which sediments were formed. These sediments over time formed hard primary rocks which became reservoir rocks in which the hydrocarbon molecules were initially contained at great depth. Coal gas called Grisou which is methane, a component of natural gas.

3.2. Definition of petrochemicals

a) Petroleum:

Petroleum is a liquid of natural origin, a mineral oil composed of a multitude of organic compounds, essentially hydrocarbons trapped in particular geological formations, because petroleum provides almost petroleum all liquid fuels (fuel oil, diesel, kerosene, gasoline, LPG). Broadly speaking, the two main processes involved in petrochemicals are steam cracking; capable of transforming gas or naphtha into olefins such as ethylene, propylene, butenes and butadiene and reforming; catalytic converter that only processes naphtha to produce major aromatic intermediates such as benzene, toluene and xylenes.

Crude petroleum is a heterogeneous mixture of various hydrocarbons (molecules composed of carbon and hydrogen atoms), unusable as they are. Its components must be separated in order to obtain the final products that are directly exploitable. There are generally two major types:

1. Energy products, such as gasoline, diesel, or oil;
2. Non-energy products, such as lubricants, bitumen, and naphtha, are used in petrochemistry.

- ***What is the petroleum and gas industry?***

The and gas industry is defined by upstream activities, which occur before oil and gas extraction, and downstream activities, which occur after oil and gas extraction.

- Upstream activities: include searching for and discovering oil deposits and testing them to determine their value.

- Downstream activities: include the extraction of deposits, production, shipping, refining and sale of crude oil and natural gas discovered underground. Manufacturers use these resources to make heating oil, motor oil, propane, gasoline, kerosene, butane, methane, benzene and tar.

3.3. The origin of petroleum:

The origin of petroleum is linked to the **geological processes** that occurred millions of years ago. Petroleum is a **fossil fuel**, and its formation involves the decomposition and transformation of organic matter from ancient marine organisms.

The basic steps in the origin of petroleum are as follows:

Organic Material Accumulation: In ancient seas and oceans, marine organisms such as plankton, algae, and other microscopic organisms lived and died. When these organisms died, their remains settled at the bottom of the ocean, accumulating over time.

Sedimentation and Pressure: As more layers of sediment accumulated over the organic remains, the lower layers experienced increased pressure from the weight of the overlying sediments. This pressure, combined with the lack of oxygen in the deep layers, prevented the complete decomposition of the organic matter.

Temperature and Heat: Over millions of years, the buried organic material underwent a process called diagenesis, where heat and pressure increased due to the deep burial. The temperature in the Earth's crust causes the organic material to undergo chemical transformations.

Formation of Kerogen: The organic material transforms into a waxy, solid substance known as kerogen during this process. Kerogen is an intermediate stage in the formation of petroleum.

Catagenesis: With continued heat and pressure, kerogen undergoes further transformation in a process known as catagenesis. This process involves breaking down the complex organic molecules into simpler hydrocarbons, which eventually form liquid and gaseous hydrocarbons.

Migration and Accumulation: The generated hydrocarbons, including oil and natural gas, move through the porous rock layers in the Earth's crust in a process called migration. These hydrocarbons can accumulate in reservoir rocks, forming what we know as oil and gas deposits.

Trapping: The hydrocarbons become trapped in geological structures such as anticlines, fault traps, or salt domes. This trapping prevents the petroleum from migrating further and creates reservoirs of economically viable quantities of oil and gas.

Exploration and Extraction: Humans discover and extract petroleum deposits through exploration activities such as seismic surveys and drilling. Once found, wells are drilled into the reservoirs, and the petroleum is brought to the surface for processing and use.

"It's important to note that the entire process of petroleum formation takes millions of years, and the conditions required for its formation are specific to certain geological environments. The extraction and use of petroleum as an energy resource have profound implications for the global economy and the environment."

3.4. Petrochemical product

The products resulting from petroleum refining are complex mixtures of hydrocarbons, the main petroleum products are:

- Liquefied petroleum gases (LPG): these gases mainly include propane and butane

- Gasolines: Regular gasoline – Premium fuel and Unleaded premium fuel – Aviation gasoline

- Diesel

- Jet fuels: intended to power the burners of aircraft turbojet engines

- Domestic fuel or oil

- Heavy fuel for industrial use.

a) Oil refining

Oil refining is an **industrial process** that **transforms** crude oil into **different products** such as gasoline, heavy oil or naphta.

Refining consists of **separating** the various oil cuts and **transforming** them into intermediate and commercial products.

i) Exploitation of hydrocarbons

Four stages in the process of mining hydrocarbons:

1. **Production:** (Extraction - Drilling - Off shore)
2. **Transport:** (Oil Pipeline, Gaz pipeline, pumping or compression station)
3. **Processing:** (Refining: extracting by-products; Liquefaction)
4. **Exploitation & Marketing**

3.5 Role of specialty in the oil and gas industry:

- Data analysis and processing in addition to initial training in Process Engineering
- Identifies and manages specific problems related to Process Engineering within a company or to offer a diagnosis and decision support regarding operations within a company
- This field requires general multidisciplinary skills, more specific skills, and much more specialized skills allowing the resolution of concerted problems.
- Taking into account complementary methodologies (theoretical and experimental approaches, multidisciplinary projects)

3.6. Concept on hygiene and safety

Definition: Safety is a set of rules and technical and hygiene means. It is a state of mind whose purpose is to create certain working conditions that eliminate dangers. Therefore, the presence of a security service in companies is essential to monitor protection, hygiene, firefighting and represent a system of measures intended to perfect production processes.

Safety studies the industrial dangers of accidents, occupational diseases and develops methods for reducing, preventing and distributing accidents.

a. Objectives of the security service

Labor protection presents a vast system of measures intended to safeguard the moral and physical health of the worker; for this it is necessary to perfect production processes and create safe working conditions. The security service must be able to ensure: - Labor legislation (laws) - Safety technology - Work hygiene - Protection against fires

b. Role of security technology

The security technique aims to create:

- Safety devices protect personnel against electrical risks
- Devices protect machinists against moving parts of machines
- Devices protect the environment against harmful and dangerous gases

c. The main tasks of the hygienist

The hygienist is called upon to resolve problems posed by:

- Noise
- the cold
- Heat
- Humidity
- abnormal pressure
- Vibrations
- Radiation
- lack of lighting
- psychological tensions

A. To understand

- Design criteria and performance limits of suction systems

- Common causes of explosions and fires and appropriate prevention and response techniques

- The difference in concept between toxicity and toxic risk (any product can be manufactured and used safely despite its toxicity)

B. To expect

- Production problems or safety problems occurring when a dangerous or toxic substance escapes due to wear of equipment (valve, pump, reactor)

- Dangerous situations caused by electricity, reactors, occasional operations.

C. Assess

The risks posed by atmospheric pollutants and therefore choosing the appropriate instrumentation

D. Interpret

The data collected and, if necessary, provide effective means of general and individual prevention.

3.7. The causes of a danger

The major causes which can cause danger are:

- The increase in the size of production units, which has the following consequences:

- Large storage areas
- Considerable tonnages transported

- The diversity of products and increase in their dangerous characteristics

- The operating conditions of the units close to their limits to improve their performance

- Urbanization around the sites which:

- Increase the power of nuisance
- Worsen the consequences of accidents

3.8. Potential dangers of the industry

- Explosions (deflagration-detonation)

- Gas and vapor explosion
- Explosion of powders and dust

- Thermal explosion
- Physical explosion

- Combustion and fires

- Dust
- Layers of powdery products
- Gases and vapors
- Liquids
- Emissions

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