

Professions in Science and Technology (MST 1)

1 15/11/2023
MST 1

Table of contents

Objectives	3
I - Chapter 1 : What is Engineering Sciences ?	4
1. Engineering Sciences.....	4
1.1. Careers in science and technology.....	4
1.2. Search for a job.....	7
II - Chapter 2 :Electronics, Electrical Engineering, Communication Systems and New Sensor Technologies	8
1. Electronics.....	8
1.1. Materials and Current in Electronics	8
1.2. Electronics professions:	9
2. Electrical Engineering.....	9
2.1. Application Fields.....	9
2.2. Electrical engineering professions	10
3. Communication systems.....	10
3.1. What is a communication protocol ?.....	11
3.2. Function of the communications system engineer	11
III - chapter 3 : Branches of Automation and Industrial Engineering:	12
1. Automatic and Automation:.....	12
1.1. Professions in Automation and Industrial IT:.....	12
IV - Chapter 4 : Branches of Process Engineering, Hydrocarbons and Petrochemical Industries:	15
1. Process Engineering	15
1.1. Defining Process Engineering:.....	15
2. Mining Engineering.....	17
2.1. Intervention area.....	17
3. Hydrocarbons and petrochemical industry:	18
3.1. The origin of petroleum :	19
V - Quiz	20

Objectives



Course Objective :

In the first stage, the objective is to introduce the student to all the fields covered by the domain of Science and Technology, and in the second stage, to provide an overview of the careers that arise from these disciplines. In the same context, this course also acquaints the student with the new challenges of sustainable development and the emerging professions that may result from them.

Chapter 1 : What is 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:

1. **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.
2. **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.
3. **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.
4. **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.
5. **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.
6. **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.
7. **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.
8. **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.

1. Engineering Sciences

1.1. 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.*

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!

a) 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.

1.2. 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!

Chapter 2 :Electronics, Electrical Engineering, Communication Systems and New Sensor Technologies



1. Electronics

Preamble

Electronics has penetrated widely in our daily lives:

- laptops,
- equipment of our cars,
- computers,
- media players,
- household appliances.
-

What is electronics?



1. Electronics is the science of controlling the **movement of electrons**.
2. 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.

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 millisampere.

1.2. Electronics professions:

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. Electrical Engineering

What is Electrical Engineering



Image 1 G.El

- « • Electrical engineering is the study of technical applications of electricity, the discipline that studies the production, transportation, processing, transformation and use of electric energy. »



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

2.1. Application Fields

1. 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,...
2. Electrical engineering is closely linked to the electronics and automation that it frequently uses, for the control of engines.

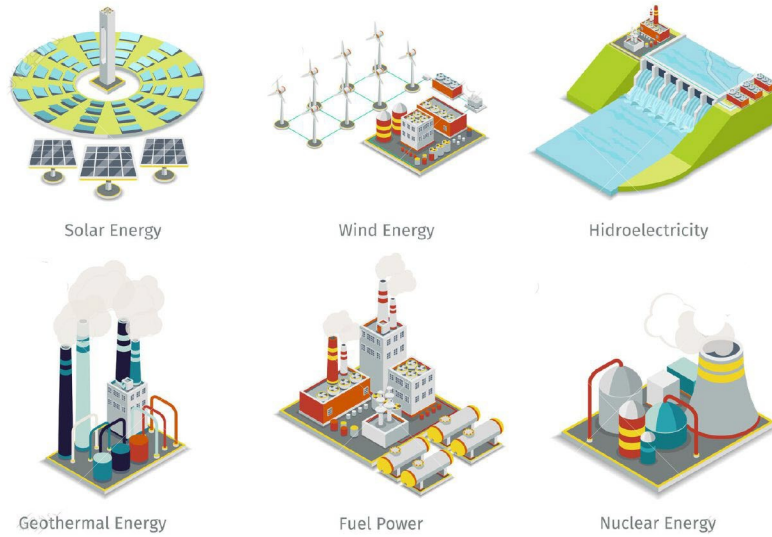


Image 2 The production of electricity

2.2. Electrical engineering professions

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

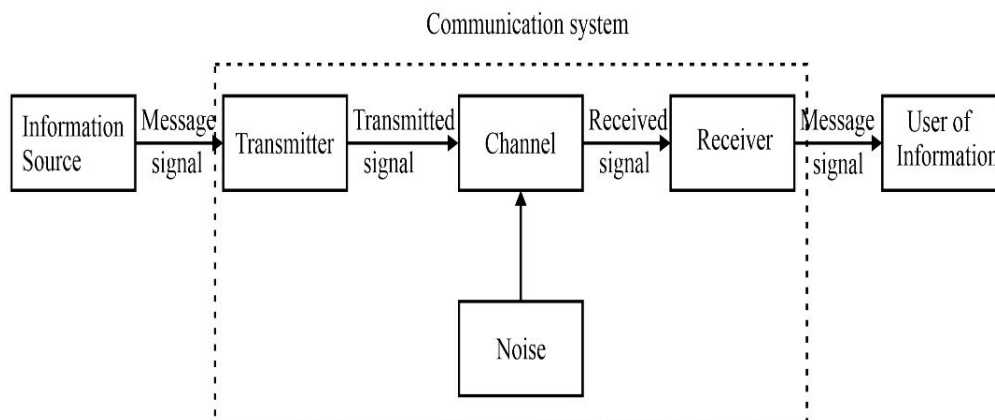
- Electrical machines (electric motors, generators, alternators, converters, etc.);
- Electrical voltage transformers;
- Electrical networks (Base Voltage, Medium Voltage, High Voltage);
- Storage (battery, capacitors);
- Electrical installations and safety equipment (meters, disconnectors, wire cutters,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

3. Communication systems

Function

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, hi-fi devices.



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.

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.

The scope of application of communication systems engineers is wide and constantly evolving.

a) Career prospects

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

chapter 3 : Branches of Automation and 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, and more.

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 IT:

1. Automation Technician or Engineer: 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.
2. 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.

3. **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.
4. **Industrial Computing Specialist:** 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.

a) 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:

1. **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.
2. **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.
3. **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.
4. **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.
5. **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.
6. **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.
7. **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.
8. **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.
9. **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.

10. **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.
11. **Telecommunications:** Automation and industrial engineering are involved in the management of telecommunications networks and the development of communication systems and devices.
12. **Research and Development:** Automation and industrial engineering are essential in laboratories and research facilities for automating experiments, data collection, and sample handling.
13. **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.

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.

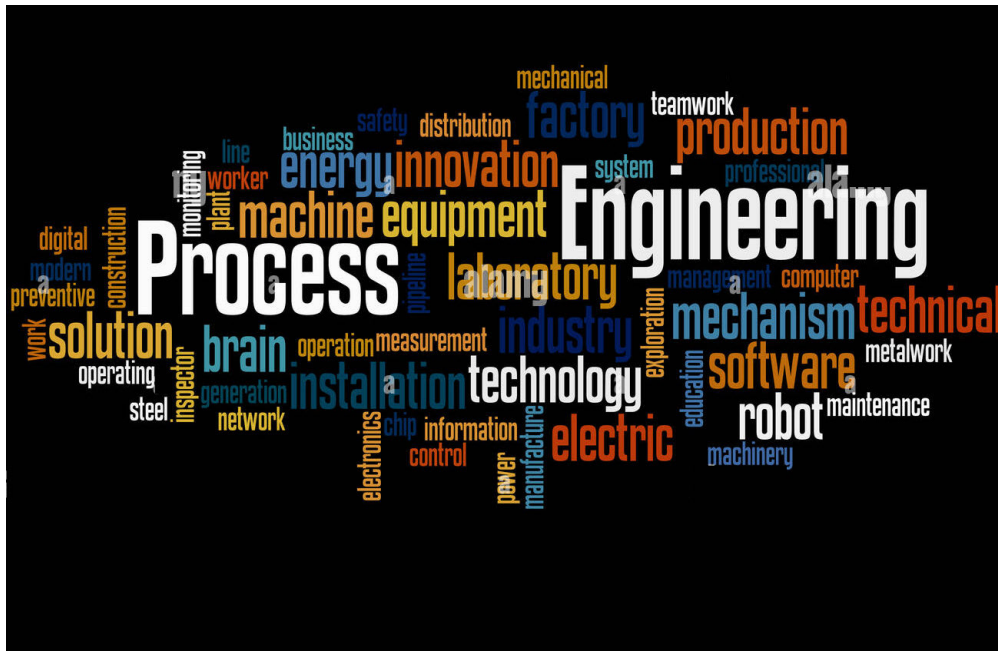
Chapter 4 : Branches of Process Engineering, Hydrocarbons and Petrochemical Industries:



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.

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.

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:

Petroleum:



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 :

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

3.1. 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."

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**

Quiz



Quiz

The origin of petroleum is linked to the geological processes that occurred millions of years ago.

- True
- False

Quiz

Fill in the Blanks

Electronics is the science of controlling the [] of [].

[] allows electronic installations to operate faster, reduce heat formation and last longer: in short, have ever higher performance.

Quiz

Choose the basic sciences for the engineer

- mathematics
- English
- Informatic
- Chemistry
- MST
- Physics

Quiz

Fill in the Blanks

Oil refining

- Oil refining is an [] that [] crude oil into different products such as gasoline, heavy oil or naphta.
- Refining consists of [] the various oil cuts and [] them into intermediate and commercial products.

Quiz

Physics is an engineering science

- True
- False