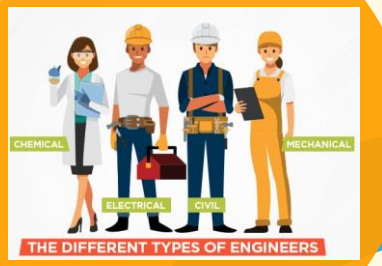
University of Batna 2

Faculty of Technology

Department of Common Core in Science and Technology

Module - Les Métiers en Sciences et Technologie 1



Electronics, Electrical Engineering, Communication Systems and New Sensor Technologies

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Content of the Presentation

1 Definition

1.1)- Engineering

Engineering is the practice of using science, mathematics, and the engineering design process to solve problems, increase efficiency and productivity, and improve systems.

Modern engineering comprises many subfields which include designing and creating infrastructure, machinery, vehicles, electronics, materials, and energy.

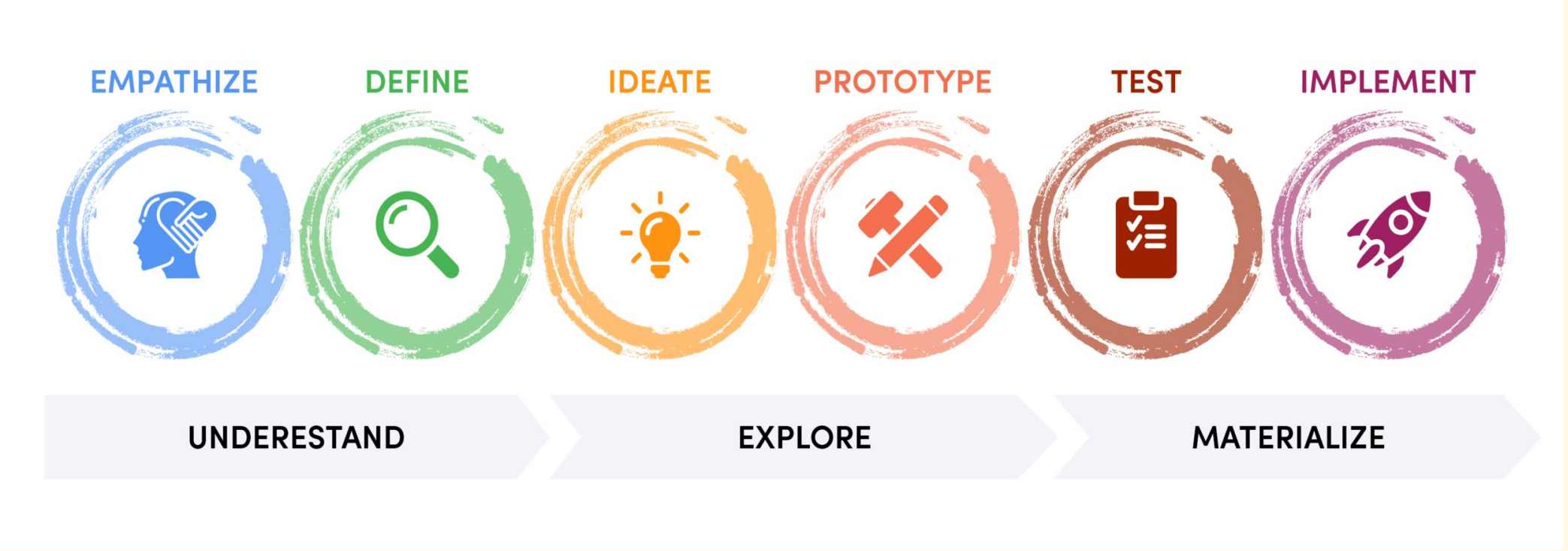
1.2)- What Does an Engineer Do?

Engineers are involved in the design, evaluation, development, testing, modification, inspection and maintaining of a wide range of products, structures and systems.

This involves everything from the recommending of materials and processes, overseeing manufacturing and construction processes, and conducting failure analysis and investigation, to providing consultancy services and teaching engineering to students and trainees.

1.3)- The Engineering Design Process

The steps to the engineering design process are : define a problem, research the problem, specify requirements, brainstorm solutions, choose the best solution, develop and design, build a prototype, test and evaluate the prototype, and communicate findings.



1.4)- Why Engineering is Important

Engineering has been a part of human history, in one form or another, for thousands of years. Of course, as our knowledge and understanding of science and mathematics grew, so our engineering expertise and competence also improved.

Today's engineers use the most advanced technologies, alongside established scientific principles, to apply cutting-edge solutions and innovation to real world challenges.

It is hard to over-emphasise the importance of engineering on human history, from designing transportation systems to powering our homes, engineering is all around us, right down to the device you are using to read this.

As our scientific knowledge continues to advance, so engineering will find ways to take this new information and apply it to the world around us.

1.5)- How Does Engineering Help the World?

Engineers shape the world around us, innovating solutions to our problems and creating new technologies to help advance society.

This ranges from air or space travel to electronics engineering and through to water supply engineering to make sure those in remote communities have access to fresh, clean water.

Helping those in need through the development of new technologies to prevent disease or protecting the planet from environmental issues, engineers use science, maths and problem solving to find answers to both local and global challenges.

1.6)- Where Can Engineering Take You?

Engineering can literally take you around the world, travelling to work on projects in foreign countries, as well as being an in-demand and well-paid career choice.

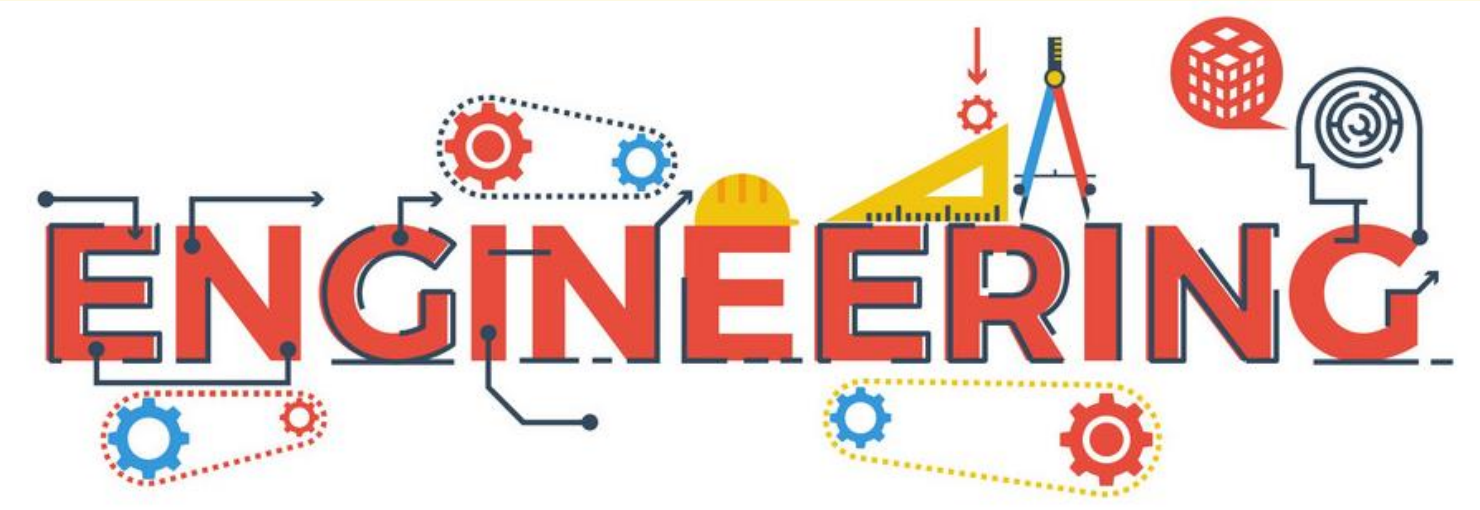
Walking the line between academia and a vocational discipline, engineering combines soft skills and academic knowledge with a practical application.

In addition, it opens up potential opportunities in consulting, technical writing, manufacturing, logistics, business and more.

1.7)- Will Engineers be Needed in the Future?

Engineers will certainly be needed in the future, and in fact, many forecasts say that the demand for engineers will actually increase.

Engineering has one of the lowest unemployment rates of any large job sectors and, as technology continues to evolve, engineers will remain integral to solving our problems and delivering innovations to society.



1.8)- Why Engineering is Important

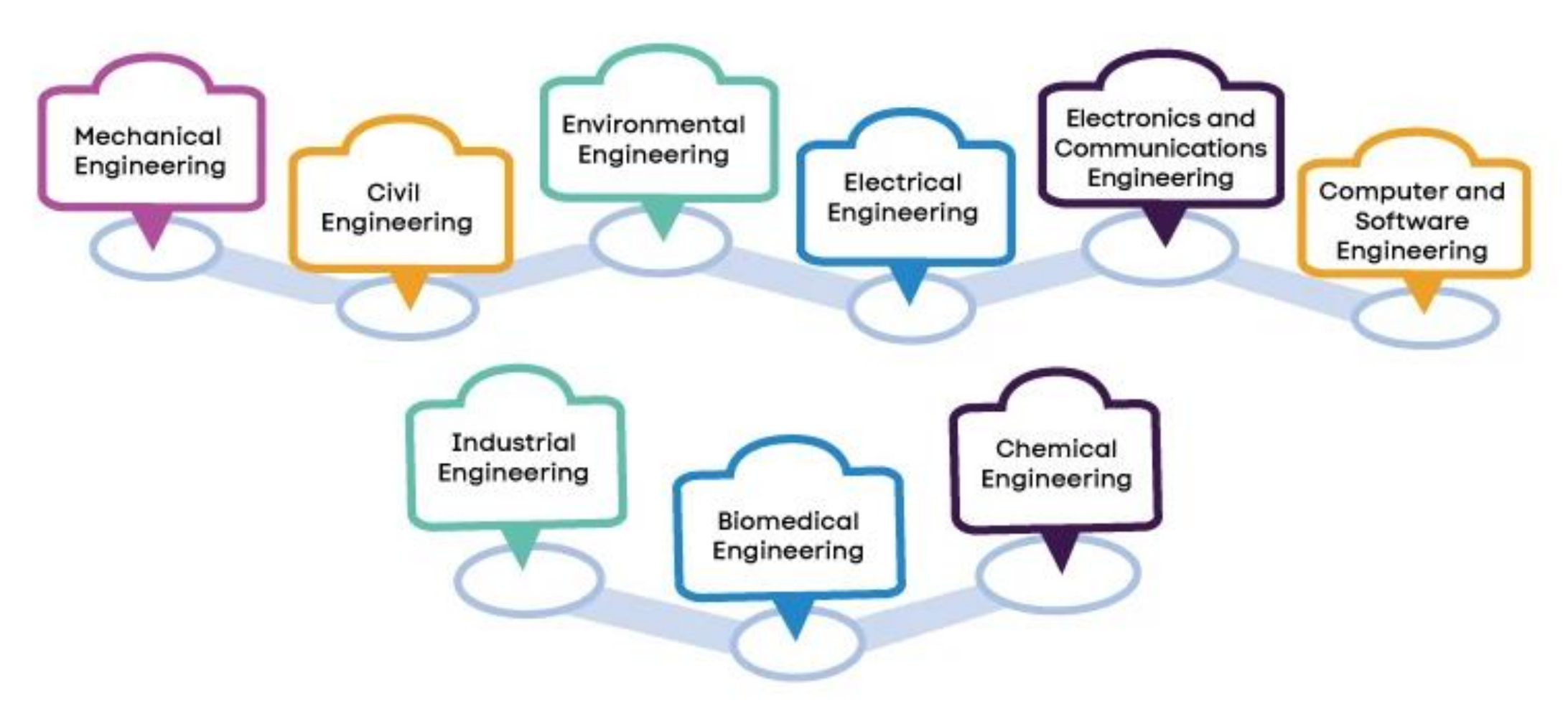
Engineering is all around us, from the device you are reading this on to the buildings we live in, cars we drive and more. From bridges to computers and medical devices to railways – engineers have been involved at some step of the way.

Although they are not required in every business, they will still have been involved in setting up or creating initial technologies.

Engineers keep pushing humankind forward, developing new innovations, protecting lives, preventing diseases and helping to keep the planet itself safe and clean.

As real world problem solvers, engineers continue to be important across all parts of society.

1.9)- Top of Engineering Topics



Electronic Engineering

2

2.1)- Electronic Engineering

2.1.1)- Definition

Electronic engineering, or electronics engineering is a form of engineering associated with electronic circuits, devices and the equipment and systems that use them.

As an electronics engineer, you'll design, develop and test components, devices, systems or equipment that use electricity as part of their source of power. These components include capacitors, diodes, resistors and transistors.

Very many people have careers in electronic engineering and find their jobs absorbing, interesting and they provide an interesting challenge that ensure Electronic engineering is all about creativity.

The whole area of engineering is about designing, making, running, and servicing things that people need.

2.1)- Electronic Engineering

2.1.2)- Fields

- ***Analogue electronic engineering :*** **Analogue electronics is still a major sector within the overall electronic engineering scene. With many analogue elements still being needed, analogue circuits are still widely used.**
- ***Radio frequency engineering :*** **Radio frequency electronic engineering has grown in its size in recent years. With many more systems using wireless links, everything from mobile phones to Wi-Fi, IoT, short range links and very much more, wireless technology is needed.**
- ***Digital development engineering :*** **Many functions are now undertaken using digital techniques. Accordingly many digital circuits are needed, and this means that some digital / logic electronic engineering is needed.**
- ***Programmable logic engineering :*** **With the complexity of many logic / digitally based circuits, an approach that is being used increasingly is one where programmable logic chips are used. FPGAs, and other programmable logic chips are widely used, enabling large amounts of logic to be incorporated into programmable chips.**
- ***Systems engineering :*** **Systems engineering is a particularly important element of the design of any item. In terms of this sector of electronic engineering, a system is any completed object.**

2.1)- Electronic Engineering

2.1.3)- Types

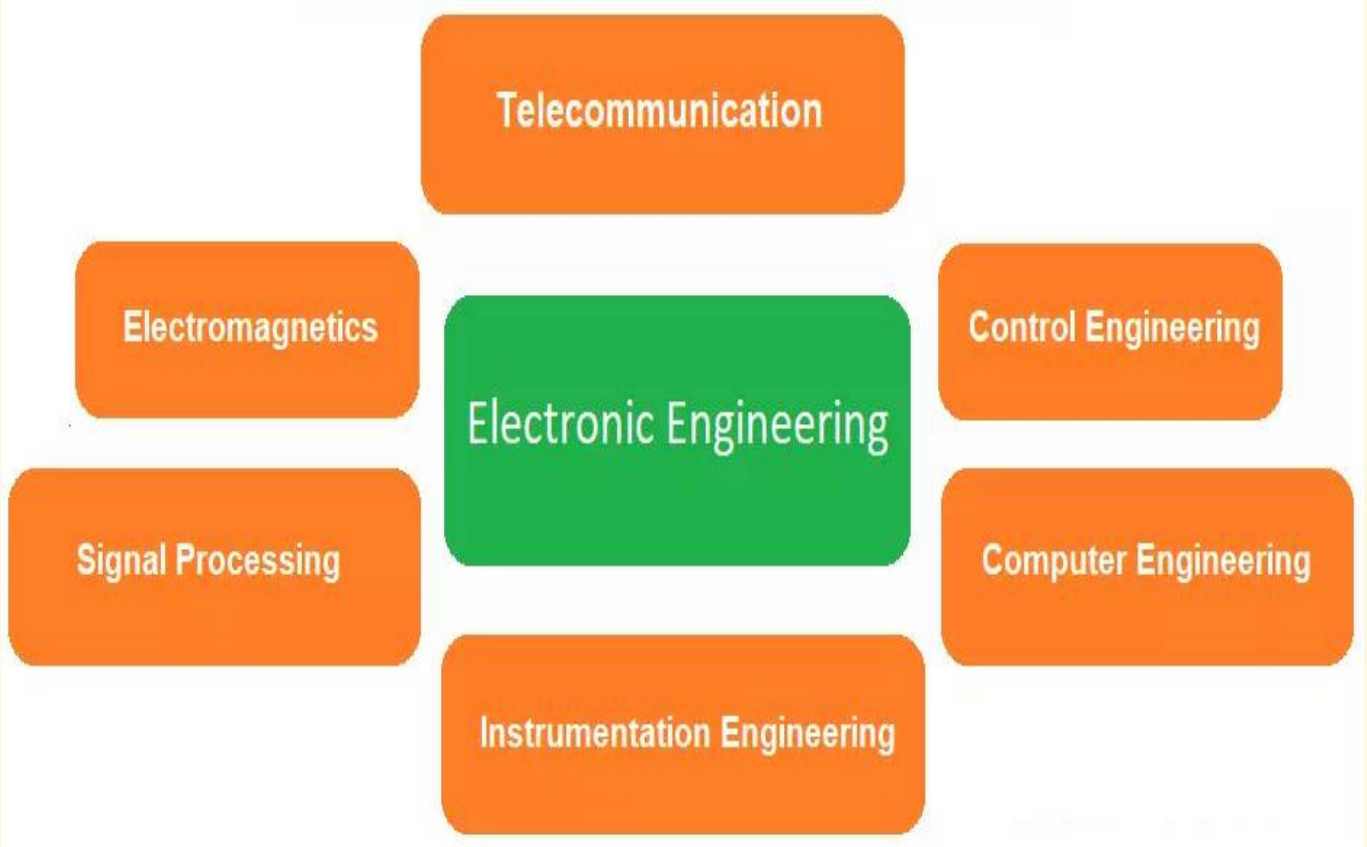
You could specialise in a particular subfield of electronic engineering, such as:

- **Control engineering,**
- **Instrumentation,**
- **Signal processing,**
- **Telecommunications engineering.**

2.1)- Electronic Engineering

2.1.4)- Branches

There are many branches of electronic engineering. In this section, I will discuss them briefly for your better understanding.

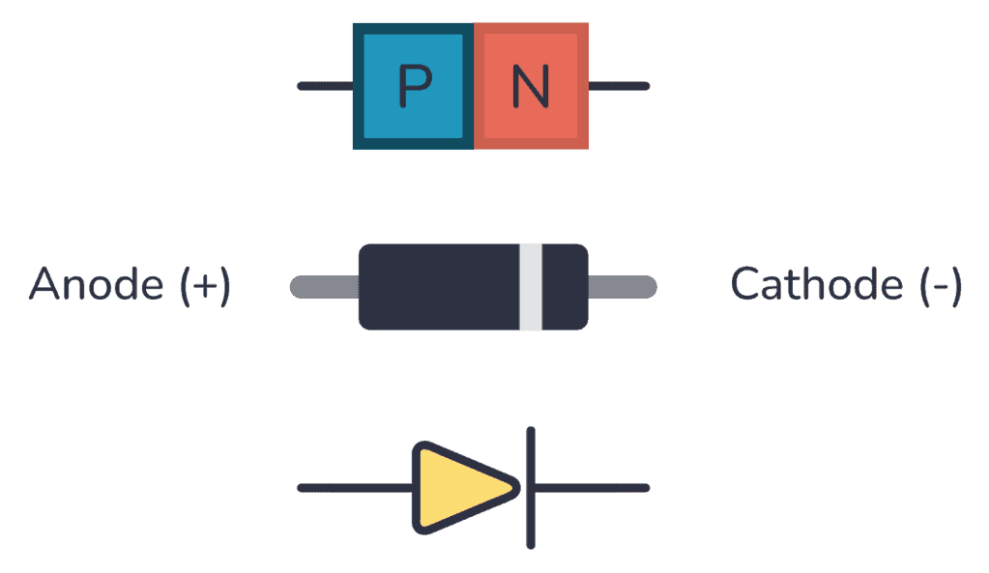


2.2)- Diodes

2.2.1)- Principal

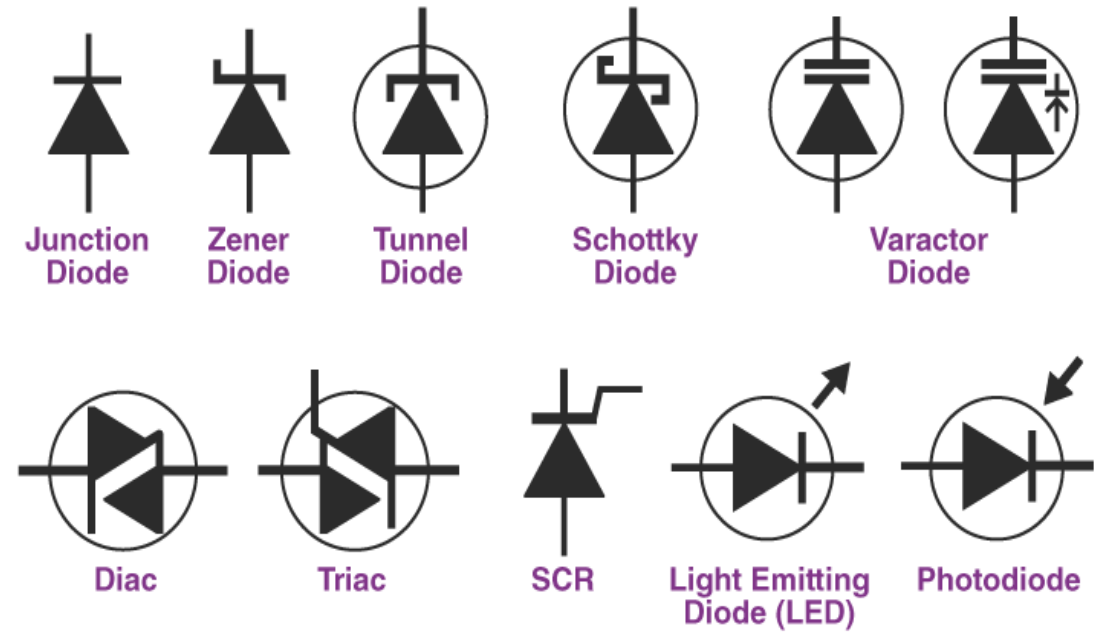
A diode is a two-terminal electronic component that conducts electricity primarily in one direction. It has high resistance on one end and low resistance on the other end.

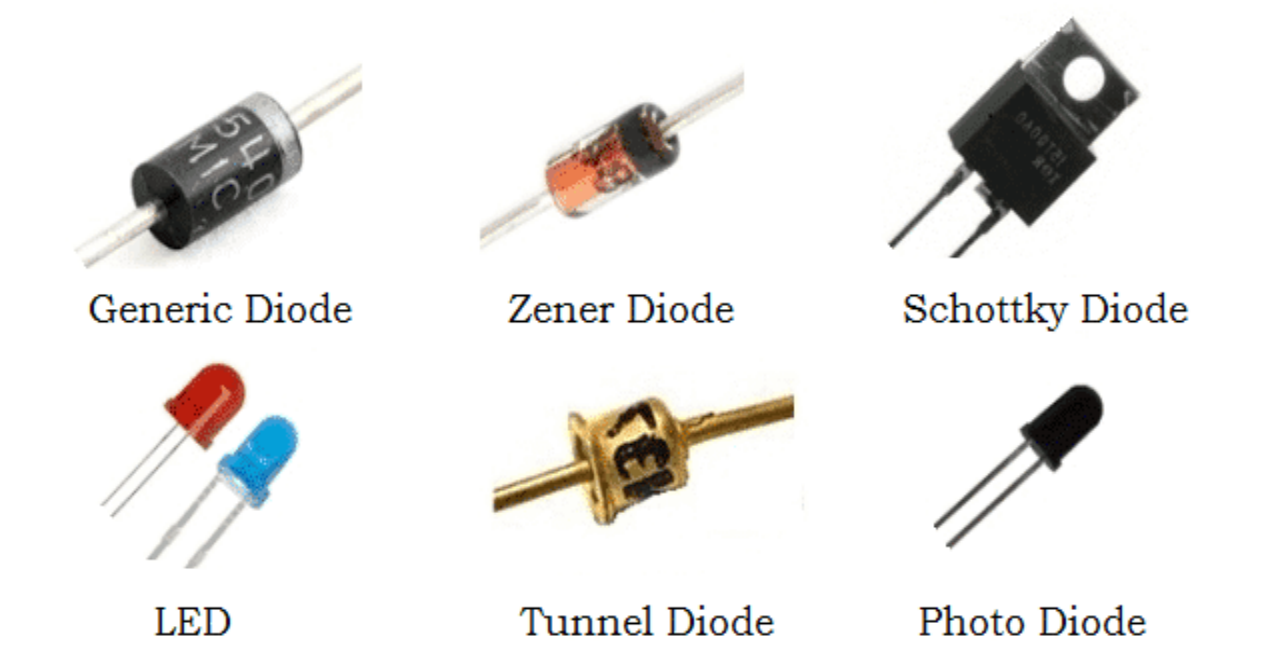
In this article, let us understand in detail about what is diode and diode symbol.



2.2)- Diodes

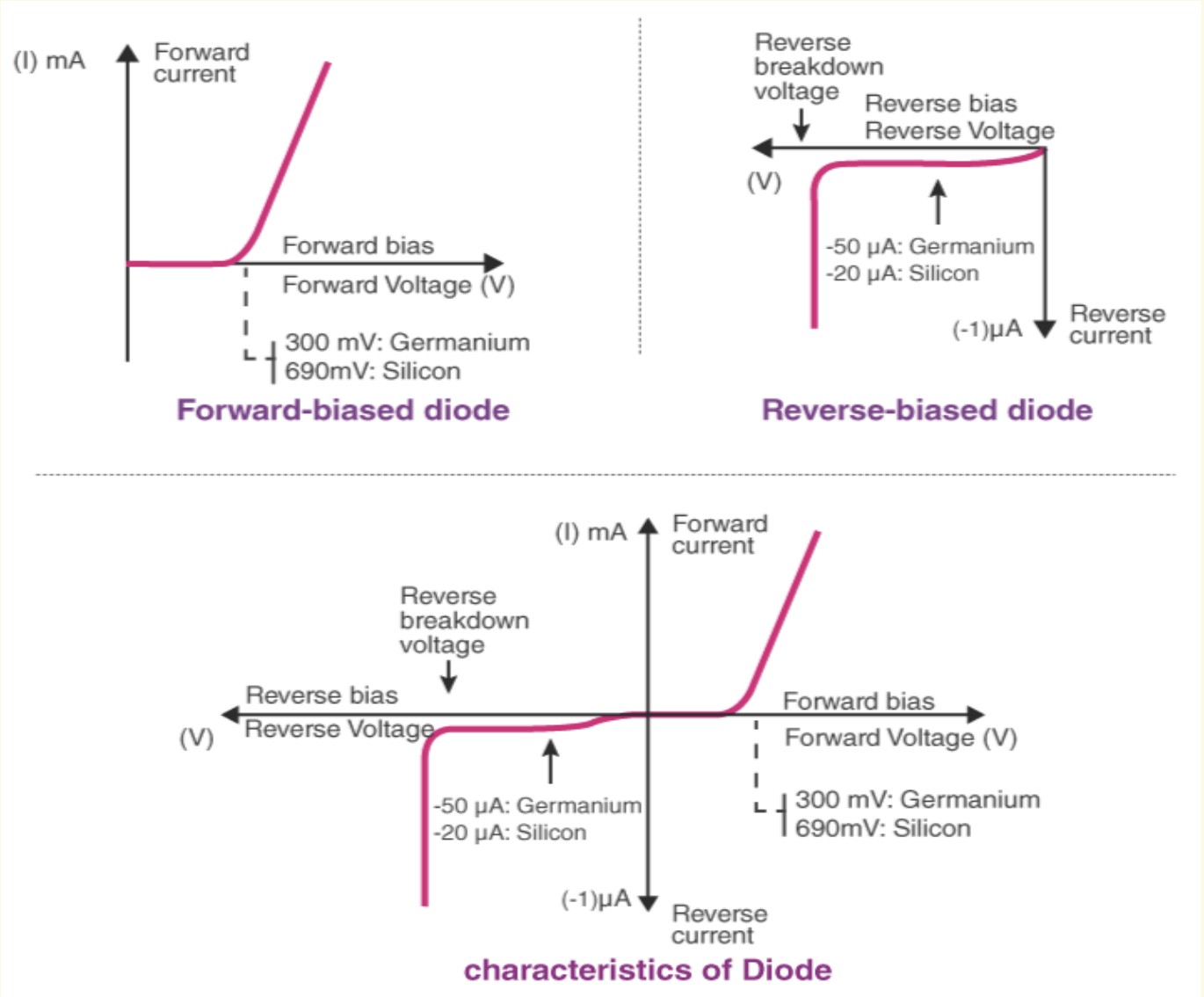
2.2.2)- Types





2.2)- Diodes

2.2.3)- Characteristics

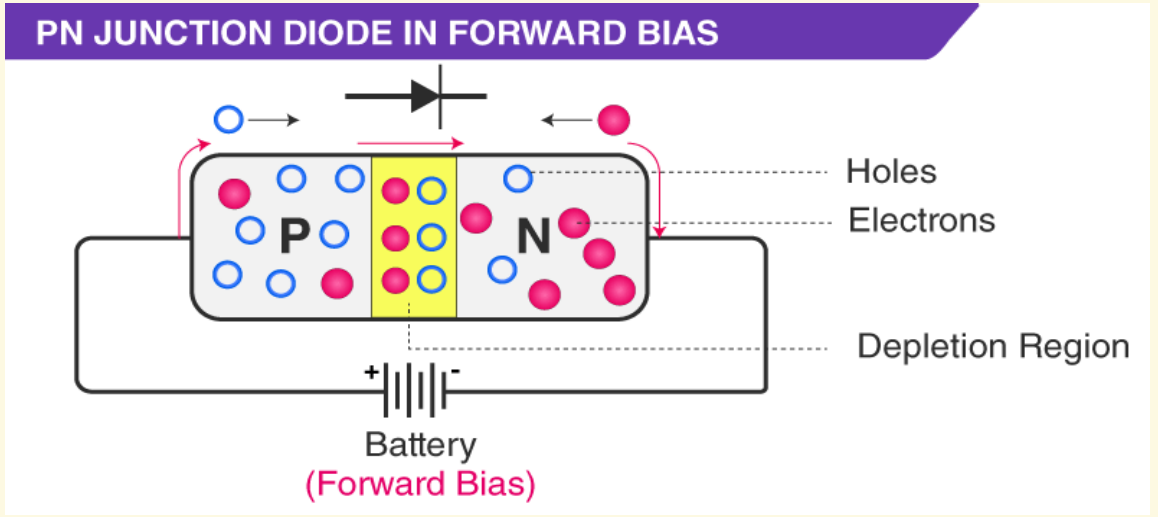


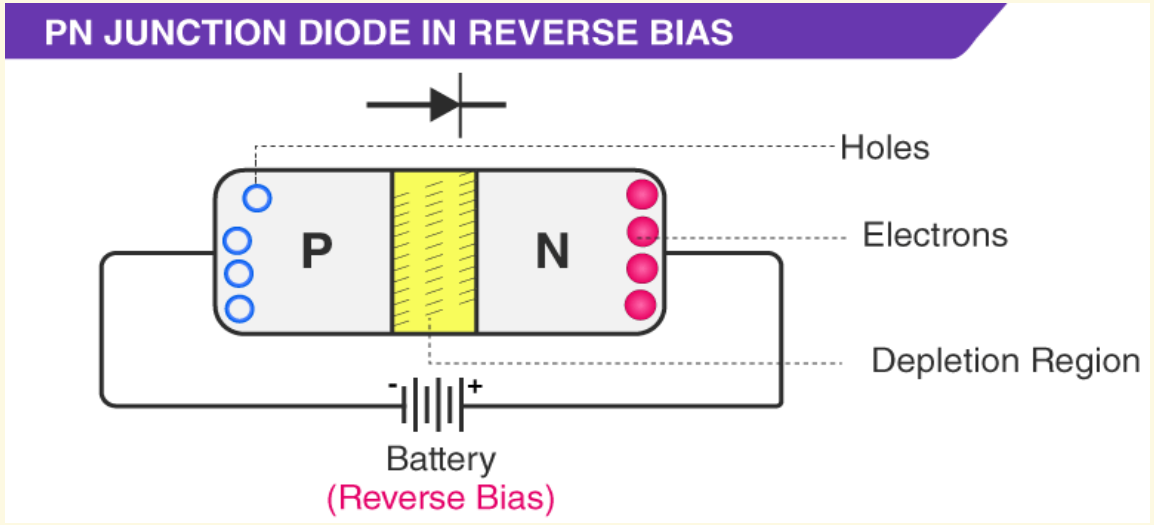
2.2)- Diodes

2.2.4)- Junctions

If the diode is in **forward bias,** the P-type region is connected with the positive terminal of the voltage source and **N-type to the negative** terminal. Electrons will get attracted to this terminal and will form a covalent bond with the P-type material. So, without any hindrance, the PN-junction diode will behave as a short circuit.

When the diode is in **reversed bias**, the P-type region is connected to the negative terminal and the **N-type is connected to the positive** terminal of the source. Because the positive terminal is connected to N-type, the free electrons are attracted towards that region due to the presence of positive terminal.



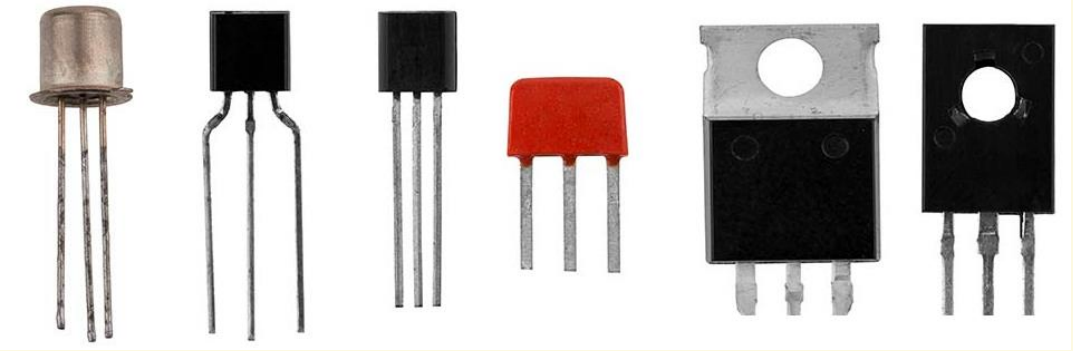


2.3)- Bipolar Transistor

2.3.1)- Principal

The bipolar junction transistor is a semiconductor device which can be used for switching or amplification. The Bipolar Transistor basic construction consists of two PN-junctions producing three connecting terminals with each terminal being given a name to identify it from the other two. These three terminals are known and labelled as the Emitter (E), the Base (B) and the Collector (C) respectively.

Bipolar Transistors are current regulating devices that control the amount of current flowing through them from the Emitter to the Collector terminals in proportion to the amount of biasing voltage applied to their base terminal, thus acting like a current-controlled switch. As a small current flowing into the base terminal controls a much larger collector current forming the basis of transistor action.

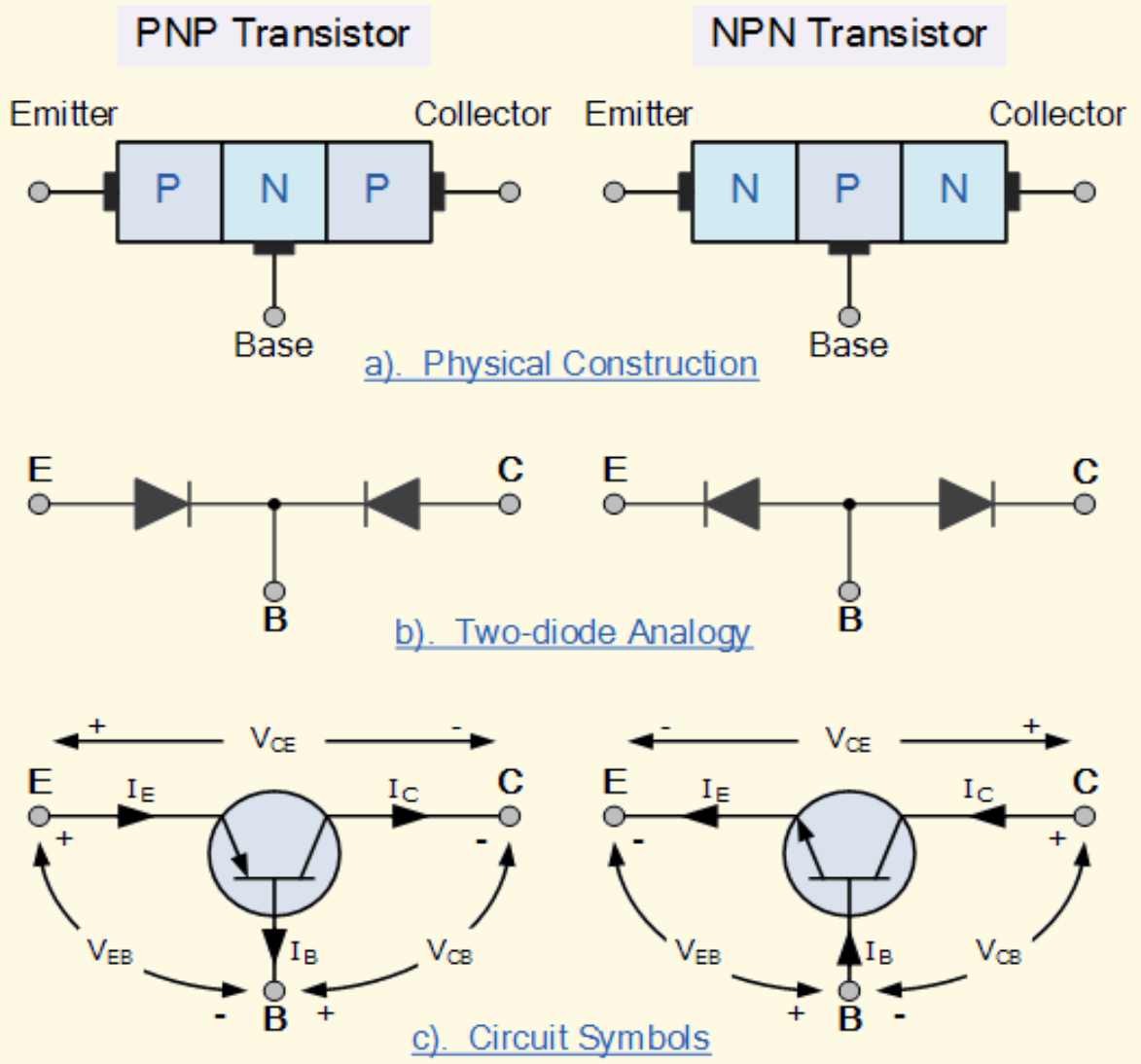


2.3)- Bipolar Transistor

2.3.2)- Classification

The construction and circuit symbols for both the PNP (Positive-Negative-Positive) and NPN (Negative-Positive-Negative) bipolar transistor are given above with the arrow in the circuit symbol always showing the direction of "conventional current flow" between the base terminal and its emitter terminal.

The direction of the arrow always points from the positive P-type region to the negative N-type region for both transistor types, exactly the same as for the standard diode symbol.



2.3)- Bipolar Transistor

2.3.3)- Terminal Device

As the Bipolar Transistor is a three-terminal device, there are basically three possible ways to connect it within an electronic circuit with one terminal being common to both the input and output signals.

Each method of connection responding differently to its input signal within a circuit as the static characteristics of the transistor vary with each circuit arrangement.

- Common Base Configuration – – – > has Voltage Gain but no Current Gain.
- Common Emitter Configuration – – – > has both Current and Voltage Gain.
- Common Collector Configuration – – – > has Current Gain but no Voltage Gain.

3

Electrical Engineering

3.1)- Electrical Engineering

3.1.1)- Definition

Electrical engineering is a modern branch of engineering that involves knowledge of physics, electronics and electromagnetism to design and develop products using or generating electrical currents.

This field has grown substantially since the introduction of electricity in the 19th century. Today, electrical power is widespread in homes and businesses across the world. Electrical engineering principles help employees install, maintain and repair these systems.

3.1)- Electrical Engineering

3.1.2)- Job Tasks

This job generally requires the ability to do the following duties:

- **Develop or improve products using electrical power,**
- **Help develop manufacturing, construction, and installation standards and specifications for electrical products,**
- **Evaluate electrical products, components, and applications to ensure they meet specific standards and codes,**
- **Conduct performance, reliability, and compliance testing,**
- **Assist with equipment and process troubleshooting .**

Electrical engineers often use engineering and design software and equipment to do their work. They also sometimes work as part of cross-functionals team on large projects.

3.1)- Electrical Engineering

3.1.3)- Competencies

Your education and training are imperative, but unless you have certain soft skills, you won't be able to succeed in this occupation. They are:

- **Communication :** To communicate ideas to colleagues and clients, you need excellent speaking and writing skills. Superior listening skills will allow you to understand clients' needs and receive feedback from them and coworkers.

- **Problem-solving :** You must be able to identify problems and come up with possible solutions. Then you must use critical thinking skills to evaluating your options and choose the best one.

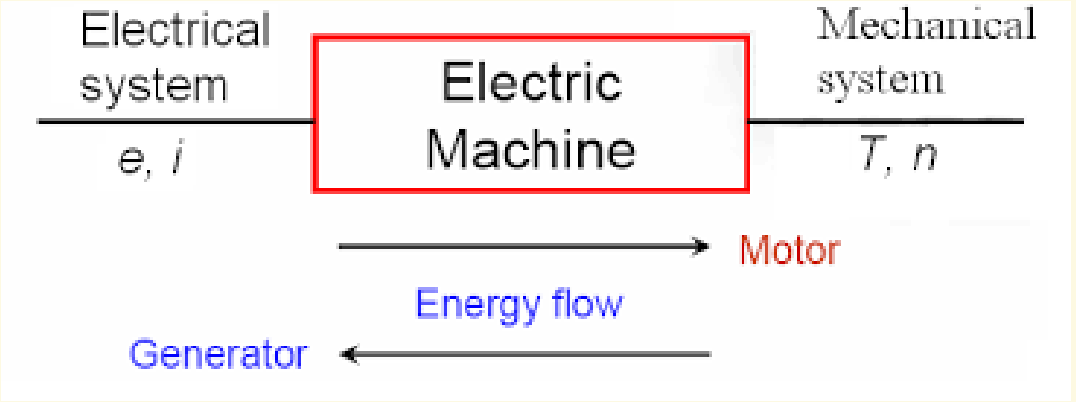
- **Active learning :** As an electrical engineer, you need the ability to acquire new information and incorporate it into your work.

- **Analysis :** You will have to be able to assess your own and others' performances, as well as that of electrical products, components, and applications, and make improvements as needed.

3.2)- Electrical Machine

3.2.1)- Principal

Electric machines are devices capable of transforming any form of mechanical energy into electrical energy and vice versa.



They are classified into two major groups: electric generators and electric motors.

An electric generator is an electrical machine which converts mechanical energy into electrical energy. A electric motor is an electrical machine which converts electrical energy into mechanical energy.

To learn more about how machines work, read the following articles

- AC machine (converts mechanical energy into Alternating Current (AC) electricity)
- DC machine (converts mechanical energy into Direct Current (DC) electricity)

3.2)- Electrical Machine

3.2.2)- Main Parts

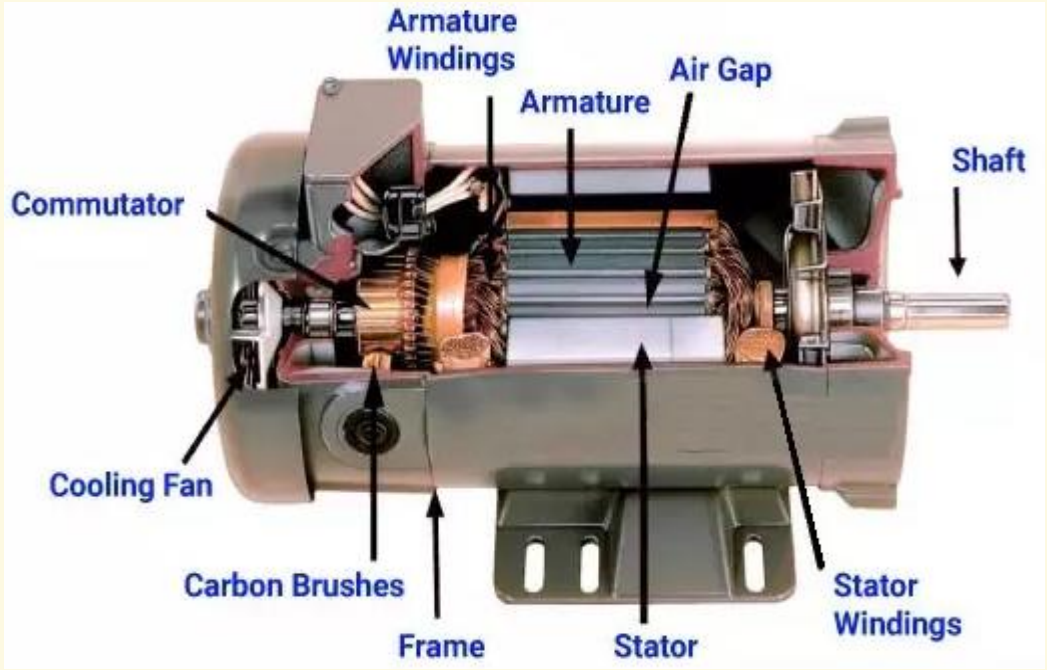
Here are the main parts of the machine :

Rotor is the rotating part of the motor that is mainly responsible for delivering the mechanical motion to the shaft or subject attached to it.

Stator is the stationary part (body) of the motor that is mainly composed of permanent magnet or windings.

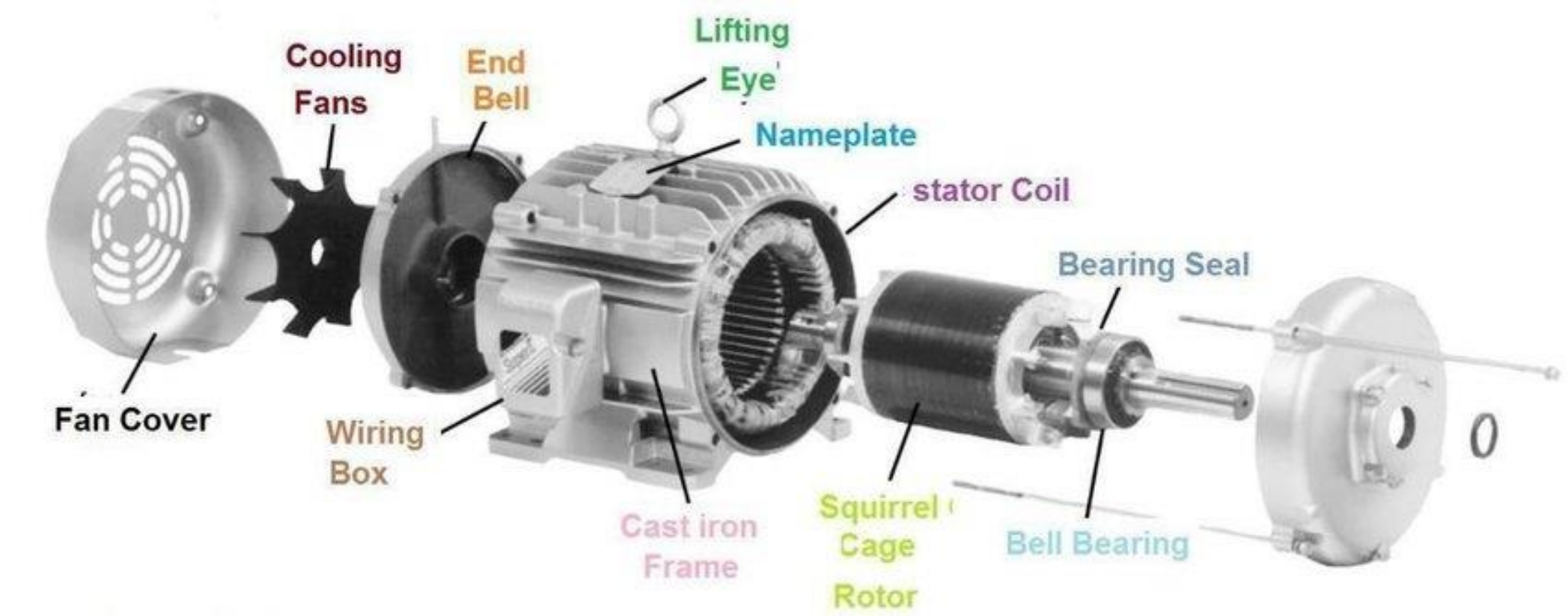
Windings are nothing but wires wrapped around an iron magnetic core that are responsible for generating magnetic poles in the presence of electric current.

Commutator is composed of slip rings that are insulated from each other and are used to toggle the input of the DC motors.



3.2)- Electrical Machine

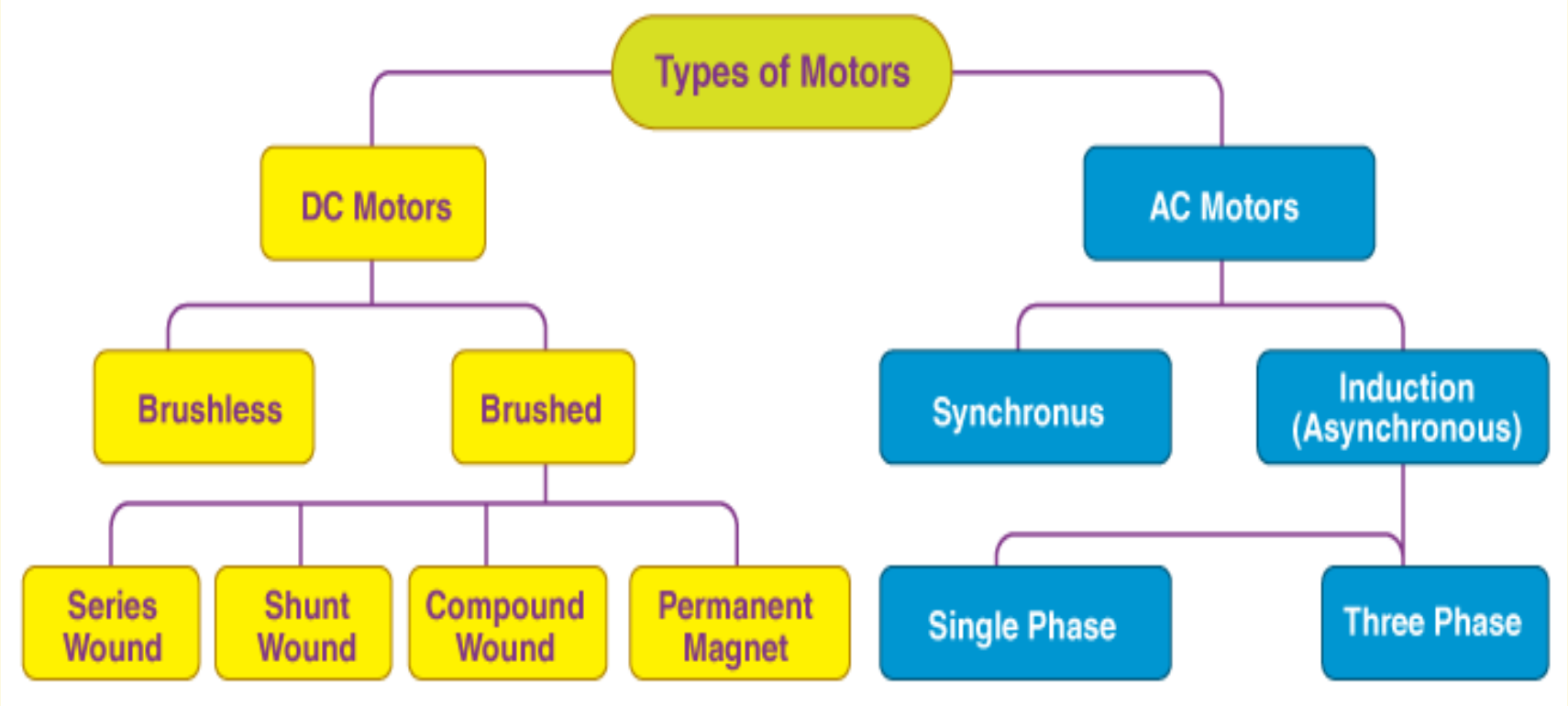
3.2.3)- Constitution



3.2)- Electrical Machine

3.2.4)- Classification

We know there are generally two types of motors, AC motor, and DC motor. AC motors are flexible for speed control and demand low power during start. On the other hand, DC motors are widely used due to its initial cost of low power units is less compared to AC and can be easily installed.



3.3)- Electrical Power System Network

3.3.1)- Definition

An electric power system is defined as a network of electrical components used to supply (generate), transmit, and consume electric power.

An electric power system that supplies power to homes and industries for a sizeable region is called an electric grid.

Electric power systems are comprised of components that produce electrical energy and transmit this energy to consumers. A modern electric power system has mainly six main components :

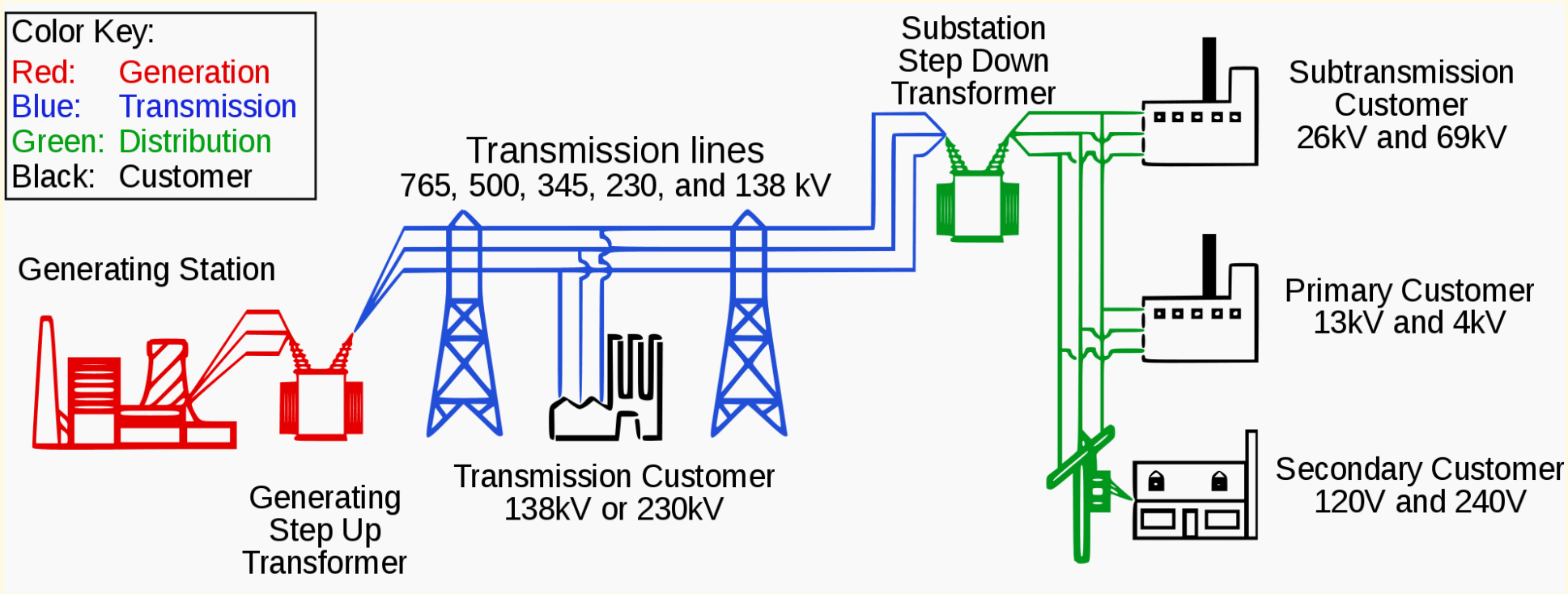
1)- Power plants which generate electric power,
2)- Transformers which raise or lower the voltages as needed,
3)- Transmission lines to carry power,
4)- Substations at which the voltage is stepped down for the distribution lines,
5)- Distribution lines,
6)- Distribution transformers which lower the voltage for the consumer equipment.

3.3)- Electrical Power System Network

3.3.2)- Classification

The power system is the complex enterprise that may be subdivided into the following sub-systems. The typical electric power system network is classified into three parts ;

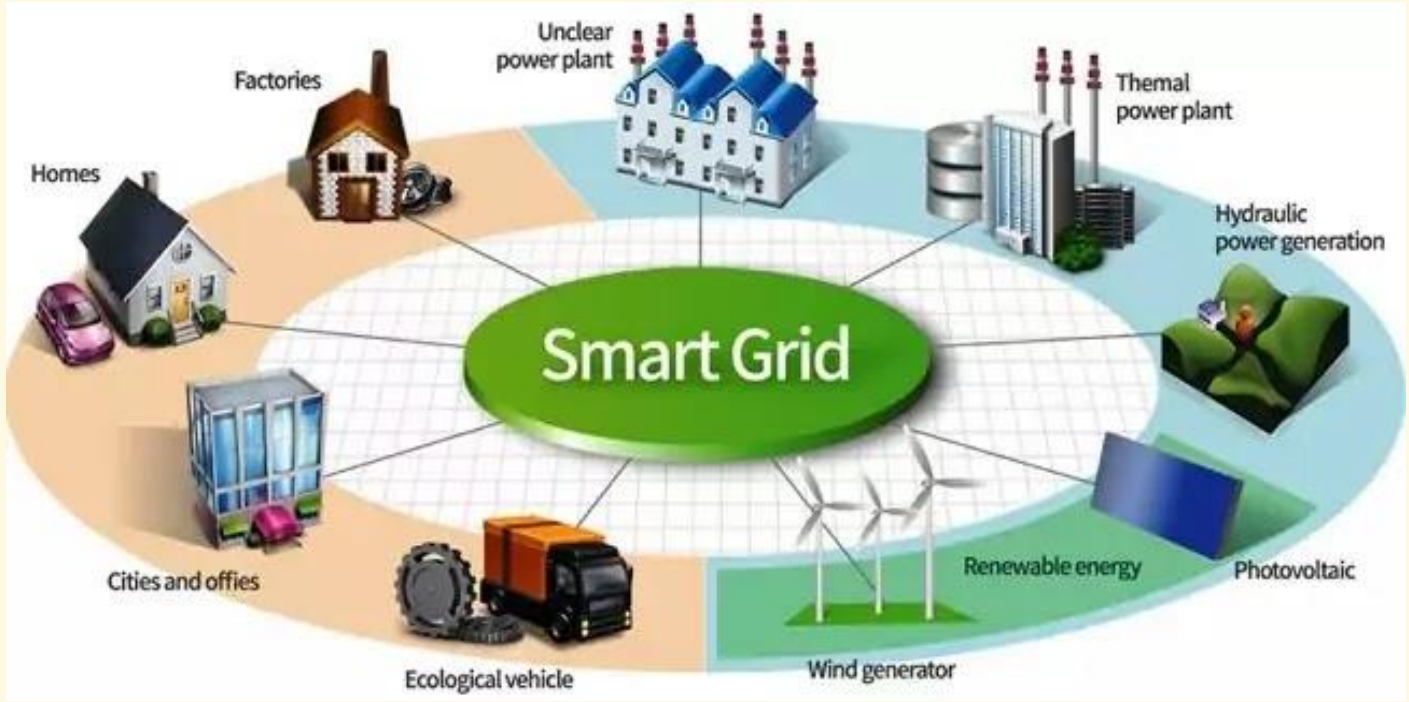
- **Generation,**
- **Transmission,**
- **Distribution,**
- **Customer.**



3.3)- Electrical Power System Network

3.3.3)- Smart Grid

Smart Grid is a term that encompasses the economic benefits of an intelligent and advanced power grid to reach changing responsibilities related directly to sustainability and energy efficiency. Considering the shortfall of alternative fuels in developed regions, the new smart grids, in order to have access to their environmental hazard, show that the average renewable energy sources can be integrated to reduce environmental disasters to improve production costs significantly.



3.4)- Renewable Energy Sources

3.4.1)- Principal

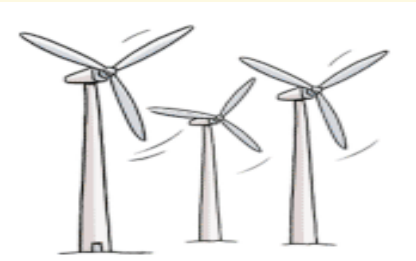
A global trend of searching for renewable energy as the primary energy source has become a growing concern to mitigate the several issues and threats of non-renewable resources. The negative consequences of green energy are significantly less, and their direct contribution to greenhouse gas emissions is almost negligible. Therefore, developing renewables as a critical player in the global energy sector is essential to promote an environmentally friendly and sustainable energy future.

3.4)- Renewable Energy Sources

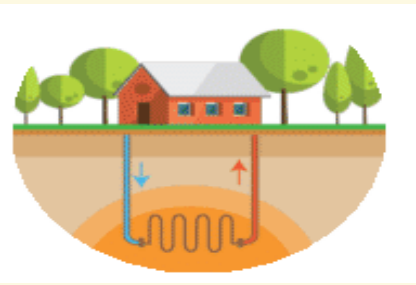
3.4.2)- Classification

Solar Energy **: The sunlight, being the source of solar energy, is available all the time on the planet and is renewable. It has the most significant potential among renewable energy sources.**

Wind Energy **: The air that flows on the earth's surface is the source of wind energy. Wind power demands stable and unidirectional wind speed, which significantly affects the potential of wind power.**



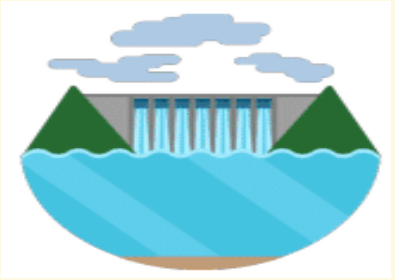
Geothermal Energy **: The below of the earth's crust possesses a massive amount of thermal energy generated by the decay of radioisotope of elements, such as uranium and thorium. This renewable energy source is independent of the sun's power and gravitational attraction.**



3.4)- Renewable Energy Sources

3.4.2)- Classification

Hydropower **: Hydropower, or hydroelectric power, is one of the oldest and largest sources of renewable energy, which uses the natural flow of moving water to generate electricity.**

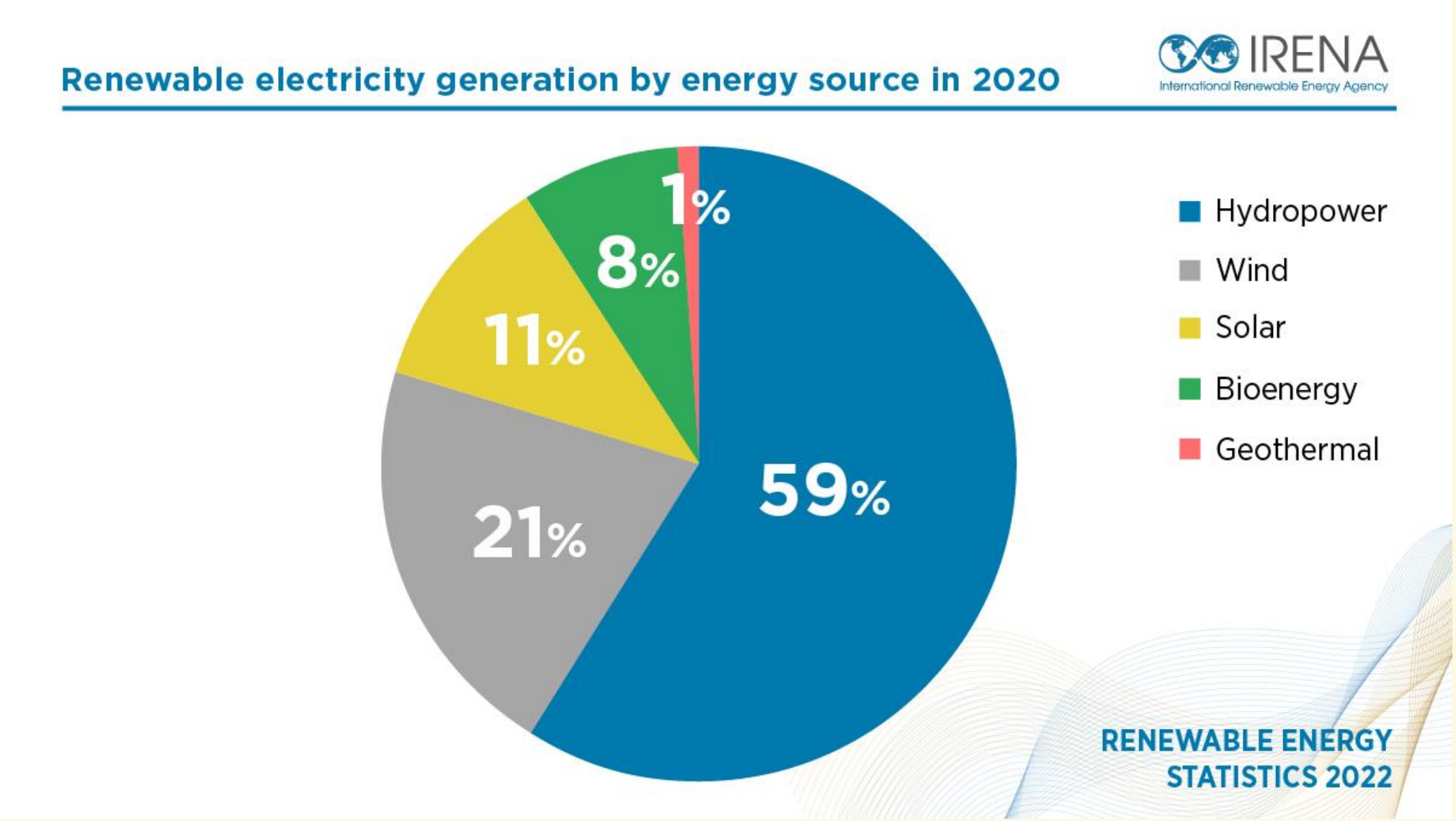


Wave Energy **: The kinetic power of the water generates wave power. The passing of wind across the seawater's surface produces waves. The converters, such as oscillating water columns, overtipping devices, and oscillating body systems, convert the waves into wave energy**

Biomass Energy **: is renewable energy from plants and animals. Plants, for instance, produce biomass energy through photosynthesis. Biomass energy is much healthier for the planet than non-renewable energy sources such as coal.**

3.4)- Renewable Energy Sources

3.4.3)- Statistics

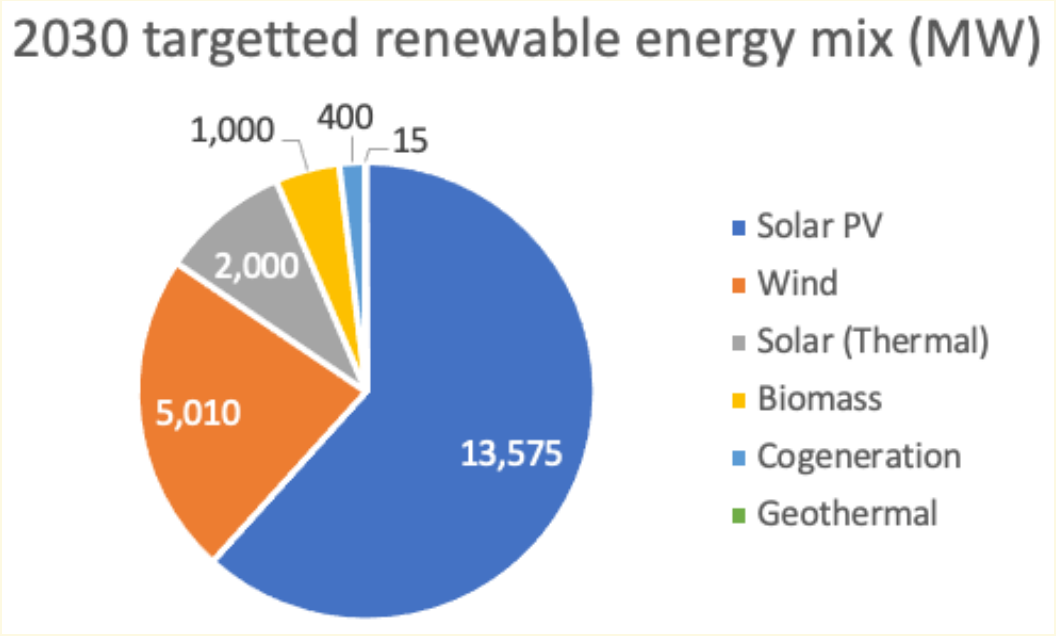


3.4)- Renewable Energy Sources

3.4.3)- Statistics

Algeria's renewable energy targets are ambitious relative to their timeframe. With approximately 450 MW of installed solar capacity today, Algeria would need to deploy an additional 5,000 MW to meet the solar capacity target outlined in the regulator's 2028 generation capacity scenario.

To meet the official 2030 targets, 22,000 MW total of renewable capacity would need to be deployed.



4

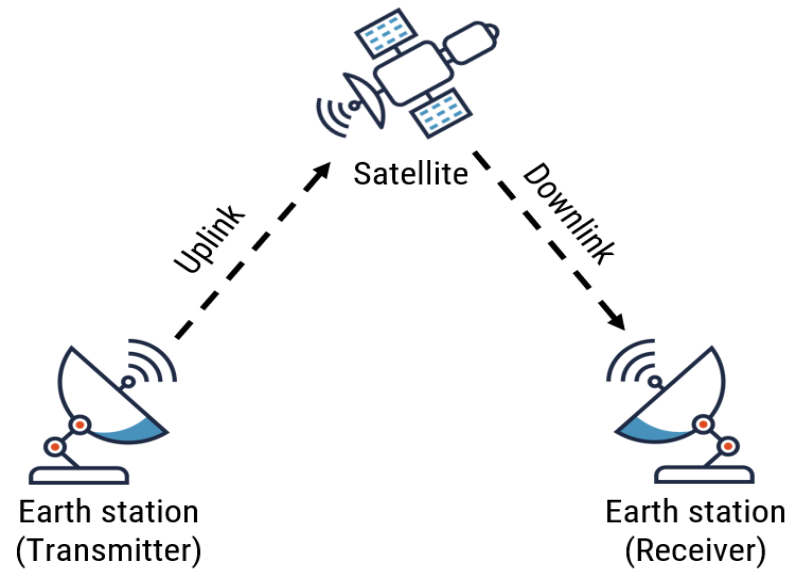
Communication Systems

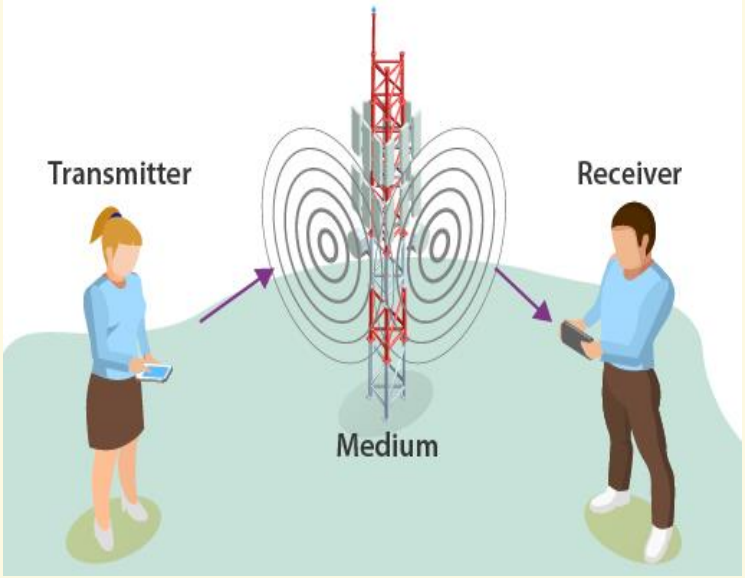
4.1)- Telecommunication Engineering

4.1.1)- Definition

Telecommunications engineering is a subfield of electronics engineering which seeks to design and devise systems of communication at a distance. The work ranges from basic circuit design to strategic mass developments.

The telecommunication engineering field varies from radio and television to satellite, computer networks the internet, and optical fiber.





4.1)- Telecommunication Engineering

4.1.2)- Telecommunication Engineer

- Telecommunications engineers or telecom engineers are expert in **managing data** such as voice, video, calls, and text over **different modes of communication**.

- They are responsible for the **designing & installation** of the telecommunications equipment and ensure the data transmitted over wired or wireless communication is of **high-quality**.

- The engineers are responsible for **examining new network technologies** and offering suggestions regarding integration.

- The engineer will take care of the **information management coordination**. The professionals will have to perform system-level design and configuration of products.

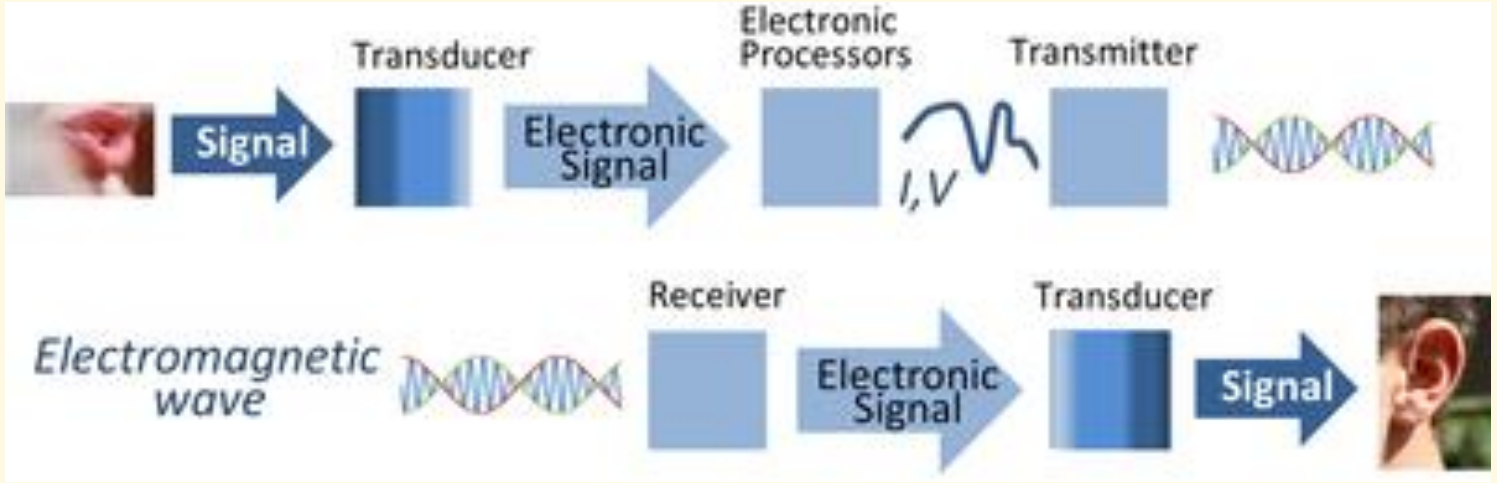
- The telecom Engineer handles **network protect** schemes, network synchronization, and bandwidth availability. The professionals will oversee the **design and maintenance** of telephone and broadband communication networks.

4.2)- Communication System

4.2.1)- Principal

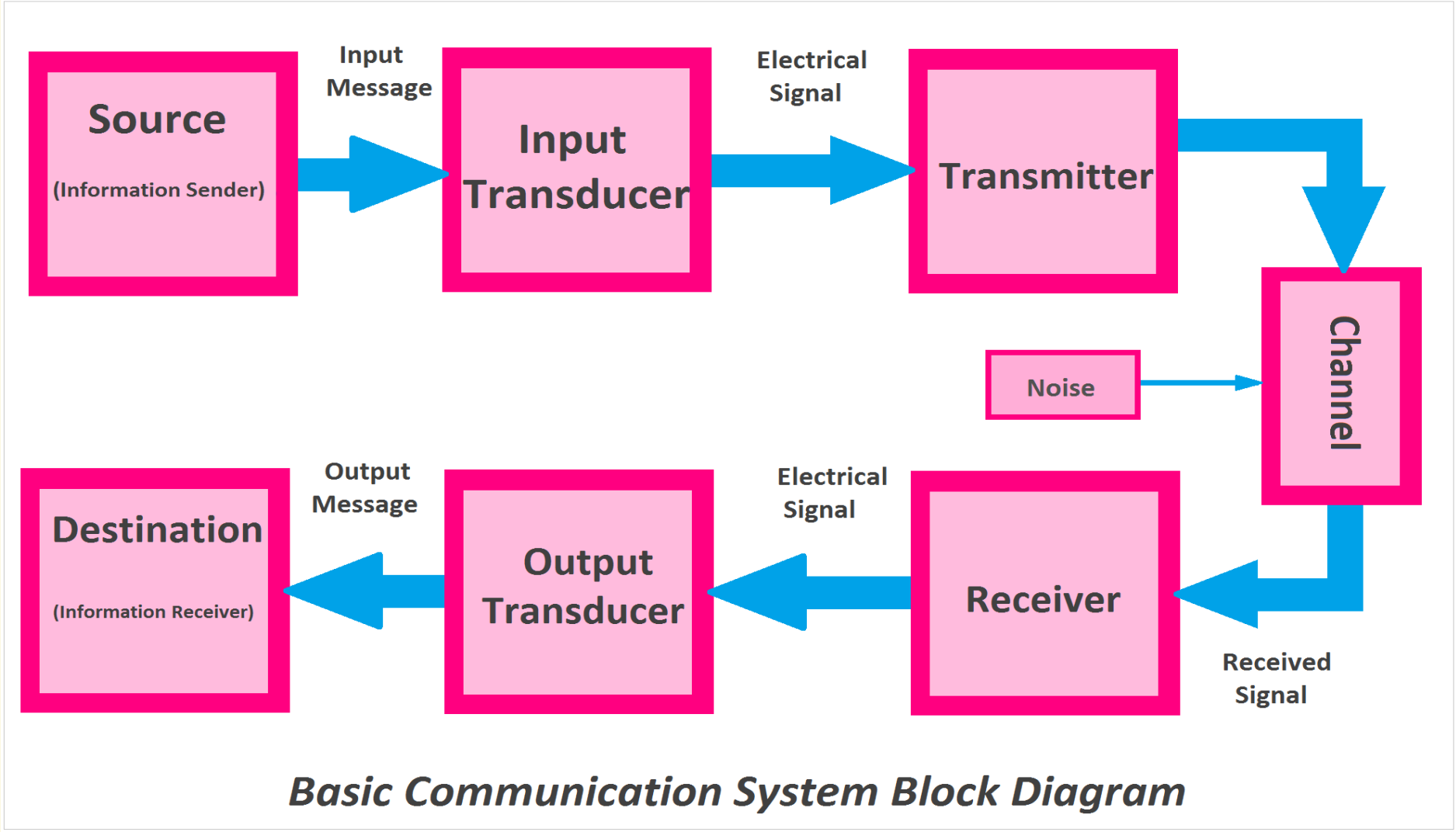
The communication system is a system model that describes a communication exchange between two stations (transmitter, and receiver). Signals or information passes from source to destination through a channel. It represents a way in which the signal uses it to move from a source toward its destination.

To transmit signals in a communication system, it should first be processed by beginning from signal representation, to signal shaping until encoding and modulation.



4.2)- Communication System

4.2.2)- Block Diagram



Basic Communication System Block Diagram

4.2)- Communication System

4.2.3)- Principal Elements

1. Signal is that information that has been converted into a digital format. Analog signals (such as human voice) or digital signals (binary data) are inputted to the system, processed within the electronic circuits for transmission, then decoded by the receiver.

2. Communication Channel is a medium by which a signal travels.

3. Transducer is the device used to convert one form of energy into another form is a transducer.

4. Receiver is a device that receives the signals sent/ transmitted by the senders and decodes them into a form that is understandable by humans.

5. Attenuation is the reduction in the strength of analog or digital signal as it is transmitted over a communication medium.

4.2)- Communication System

4.2.3)- Principal Elements

6. Amplitude an amplitude of the signal refers to the strength of the signal.

7. Amplification is the process to strengthen the amplitude of the signals using an electronic circuit.

8. Modulation as the original message signal can't be transmitted over an outsized distance due to their low frequency and amplitude, they're superimposed with high frequency and amplitude waves called carrier waves.

9. Demodulation takes a modulated signal and then extracts the original message from it.

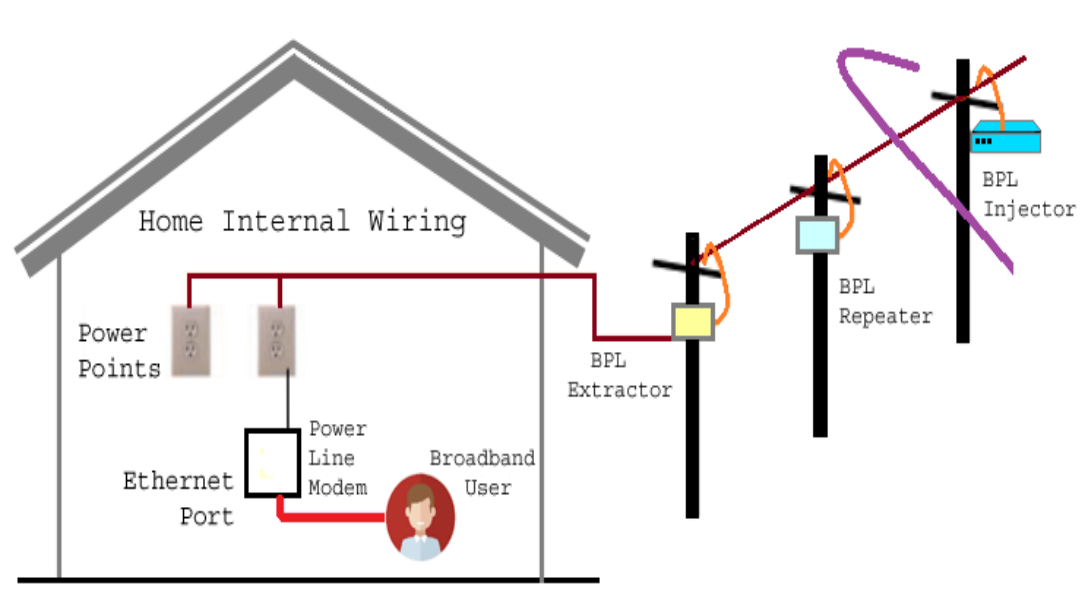
10. Repeater is the repeater extends the range of communication systems by amplifying the signals.

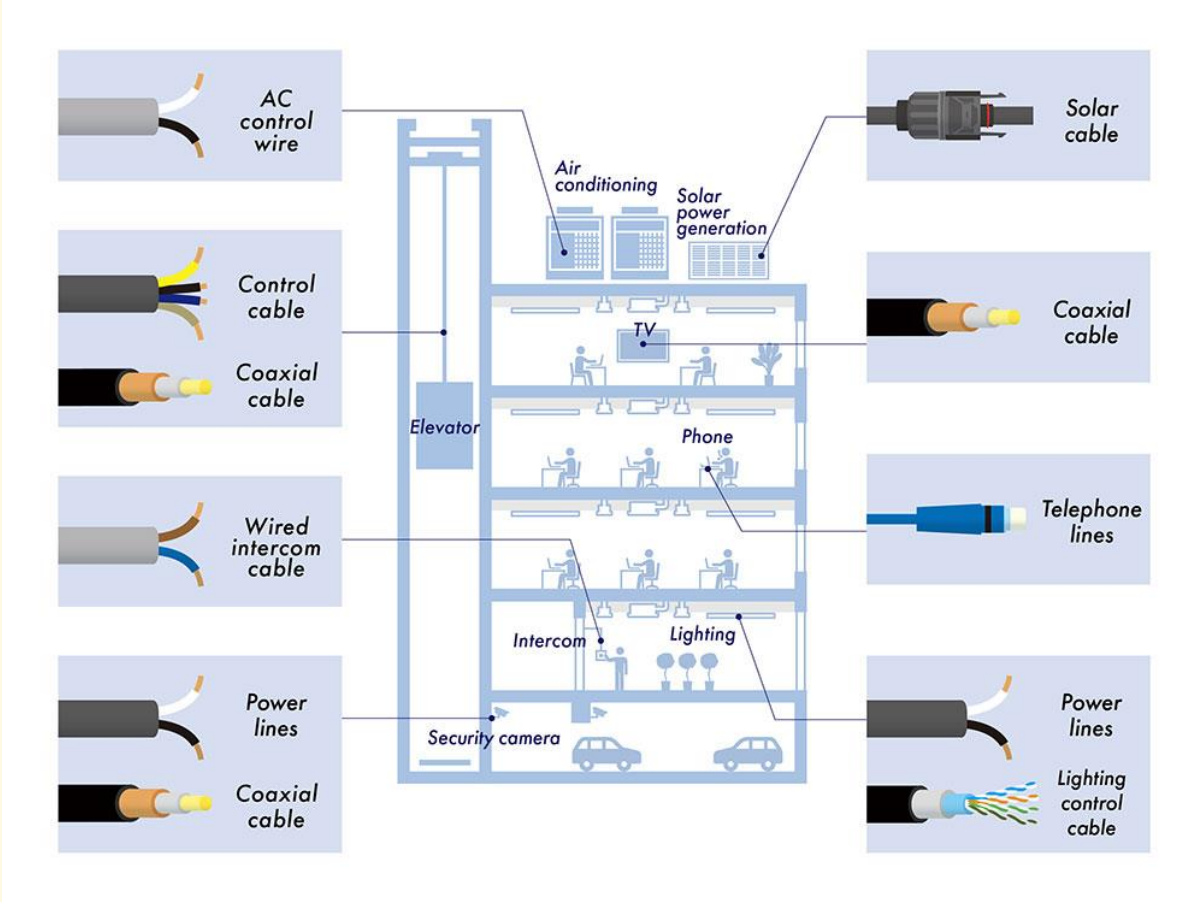
11. Noise is any electrical signal which interferes with an information signal is called noise.

4.2)- Communication System

4.2.4)- Types

Line communication systems: Uses the existing infrastructure of power lines to transfer data from one point to another point.

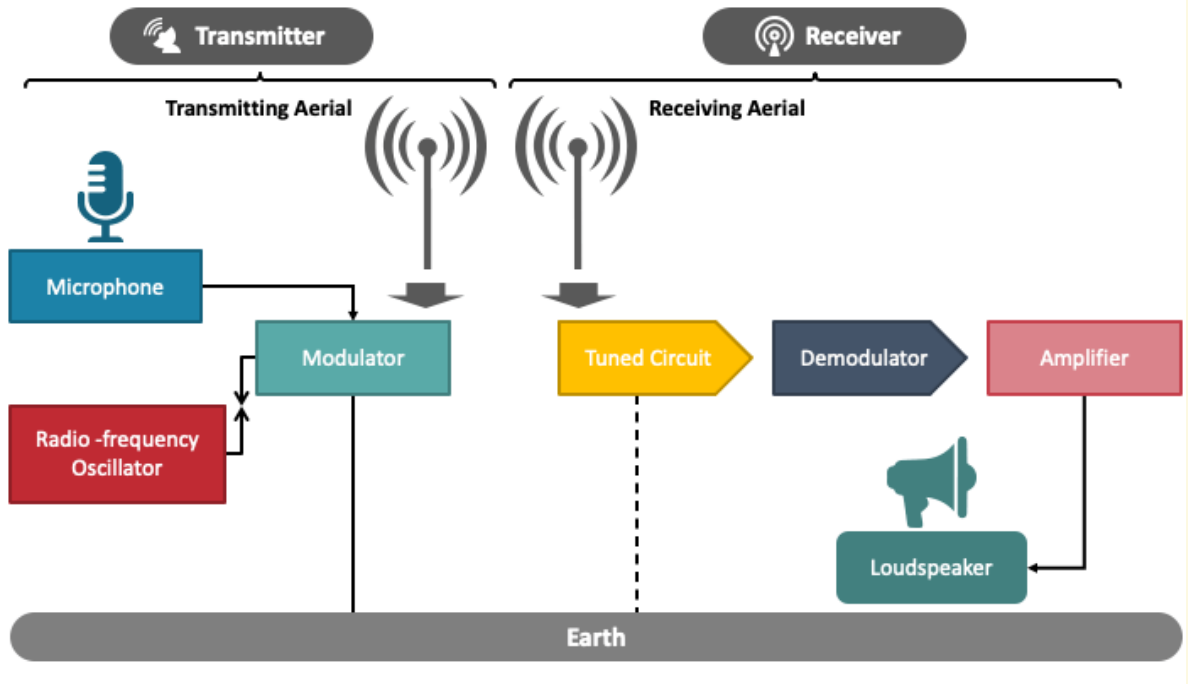




4.2)- Communication System

4.2.4)- Types

Radio Communication systems: Uses the infrastructure of radio waves to transfer the information from one point to another point.

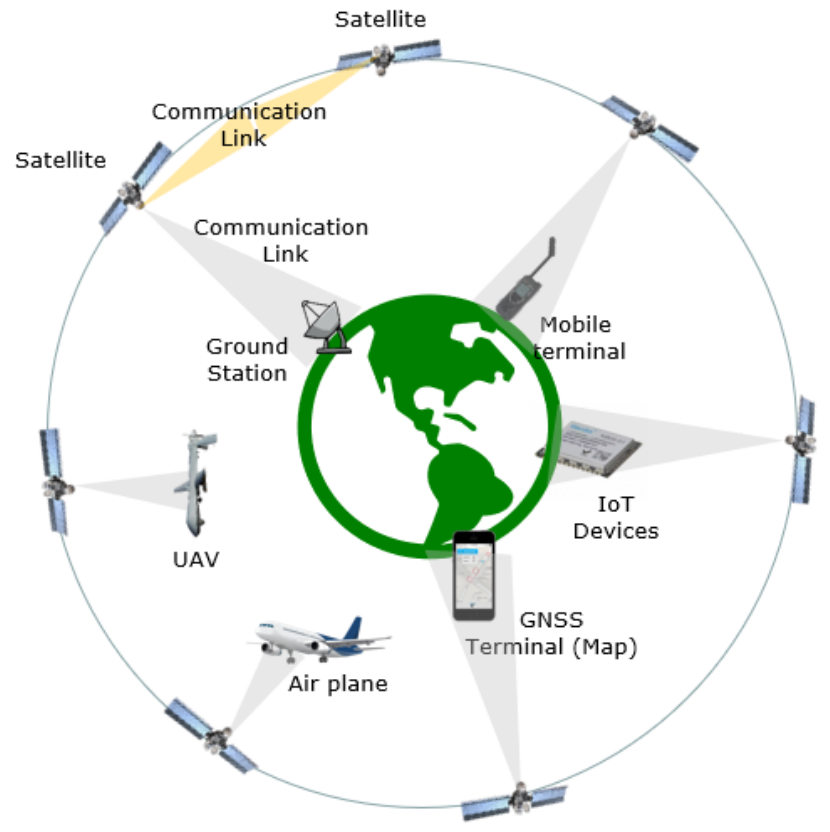


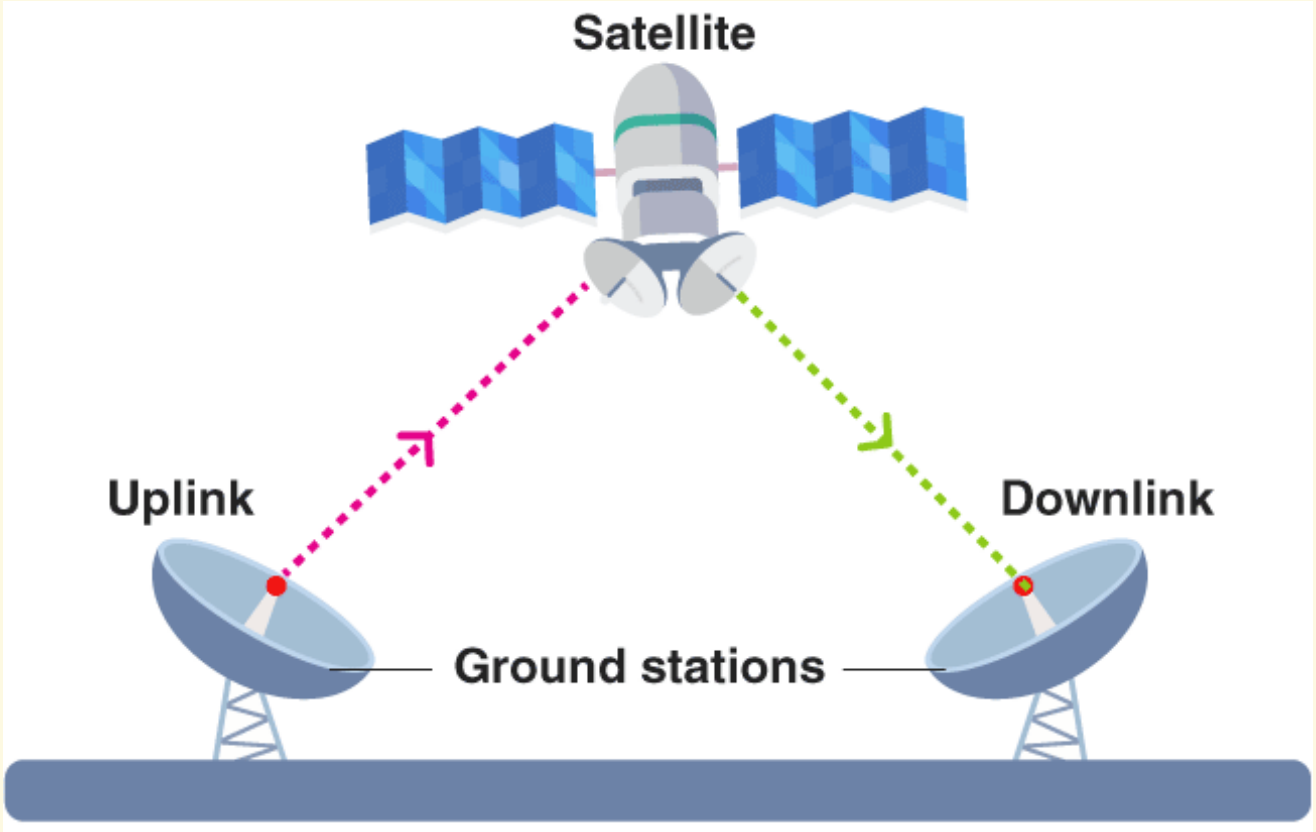
There is a physical link, called a hardwire channel between the transmitter and the receiver inline communication systems.

4.2)- Communication System

4.2.4)- Types

Satellite Communication systems: **Satellite communication is transporting information from one place to another using a communication satellite in orbit around the Earth.**





5

New Sensor Technologies

5.1)- Definition

Sensor is a device that has the capability to detect change in its surrounding environment and provides output in the form of analog or digital signal, which is then either displayed or can be used by a closed loop system for process control.

For better understanding, we can say that sensor is a device that can see, hear, feel, smell, and taste its surrounding and probably do it better than me or you (obviously it depends on the make and quality of the sensor).

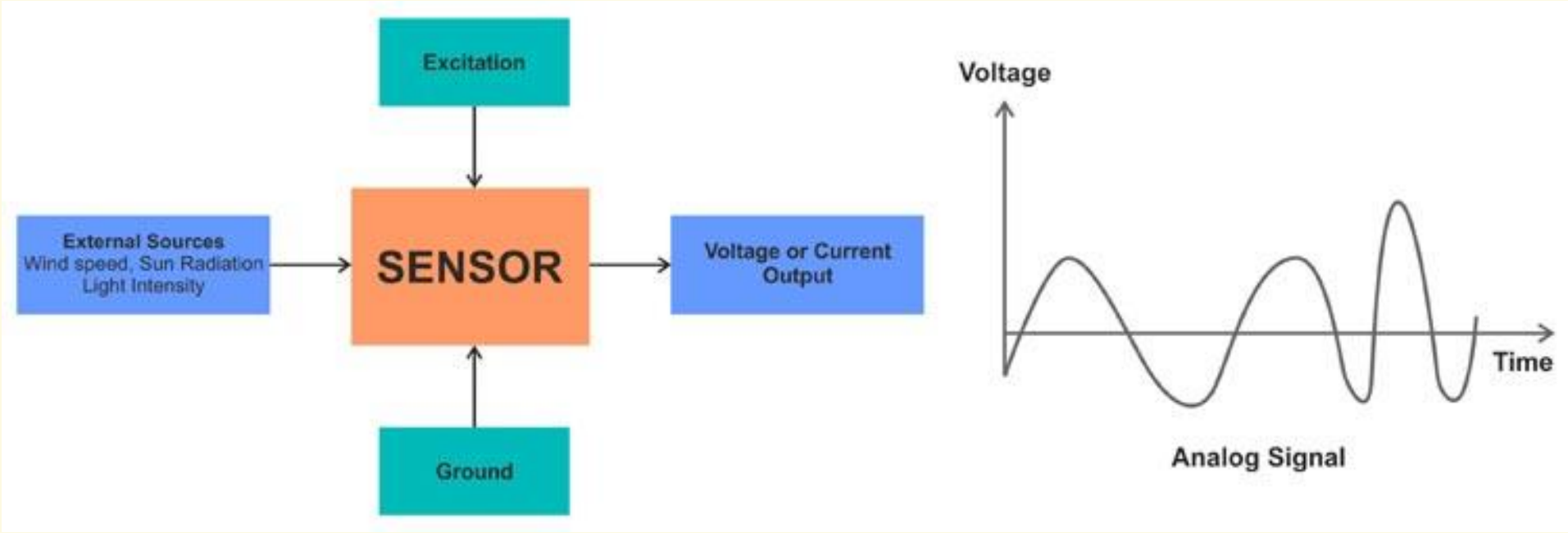
Sensors are usually connected to a transmitter because the output of sensor needs to be conditioned or amplified, because the output is very small.

5.2)- Analog and Digital Sensors

5.2.1)- Analog Sensors

The analog sensor gives output in the form of analog output when they detect change in external parameter (wind speed, solar radiation, light intensity, etc.).

An analog sensor with output range of 0 to 5 V can give the output anywhere between 0 V and 5 V.



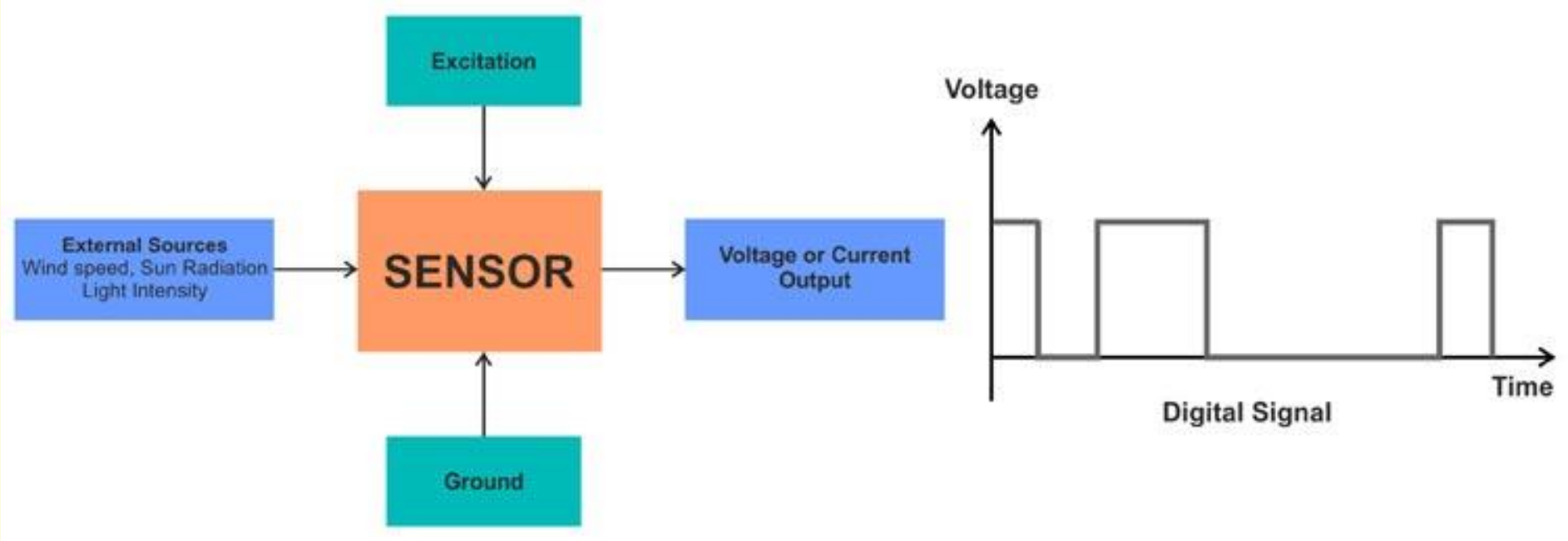
5.2)- Analog and Digital Sensors

5.2.2)- Digital Sensors

Unlike analog sensor, digital sensor produce discrete values (0 and 1).

Discrete values often called digital (binary) signals in digital communication.

***Logic High* is treated as "1" whereas the *Logic Low* is indicated by "0"**



5.3)- Different Types of Sensors

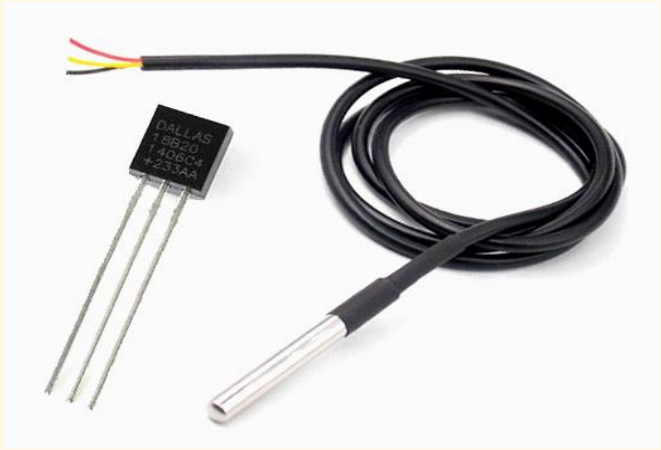
In today's time, there are multiple sensors for detecting different parameter and measuring different characteristics of physical world. Many of the sensors can be utilized in detecting data in different scenario.

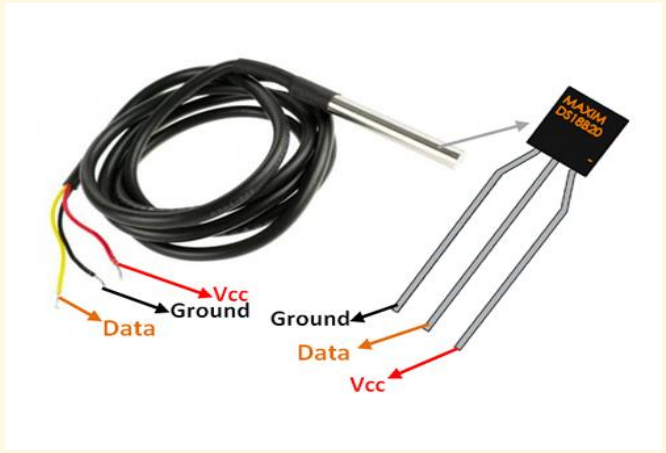
For example, an ultrasonic sensor can be used for detecting distance, speed, temperature, etc. just by using different calculation from its acquired data.

Therefore, sensors can be classified into different parameters. Sensor's can be classified based on the physical parameter it senses, they can also be categorized based on the applications, or by the industry they are being used. So, in this article, I've classified the sensors based on their most prominent usages.

5.3)- Different Types of Sensors

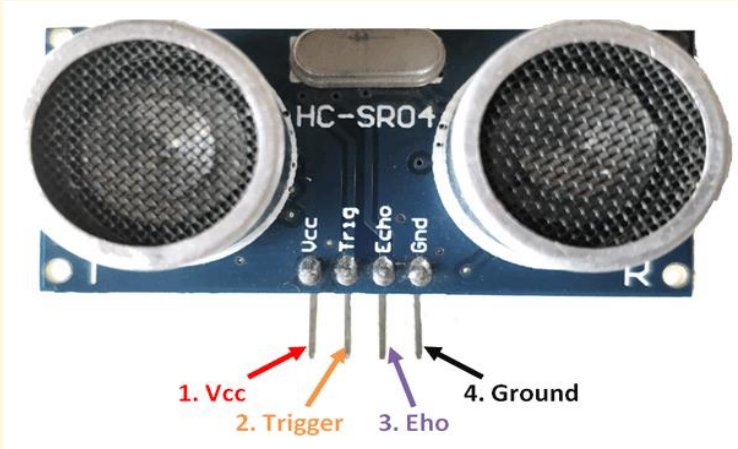
Temperature Sensor





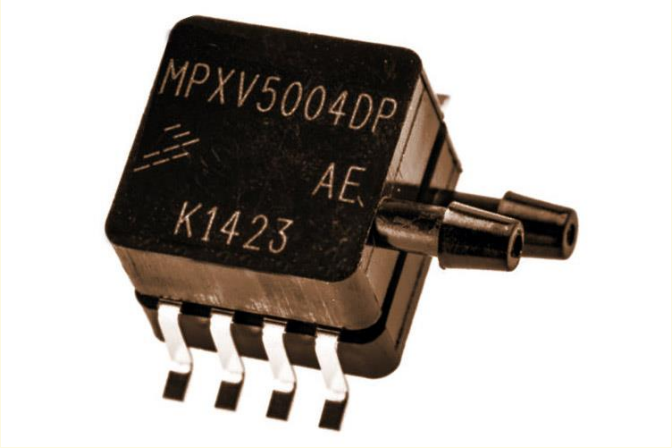
Infrared Proximity Sensor

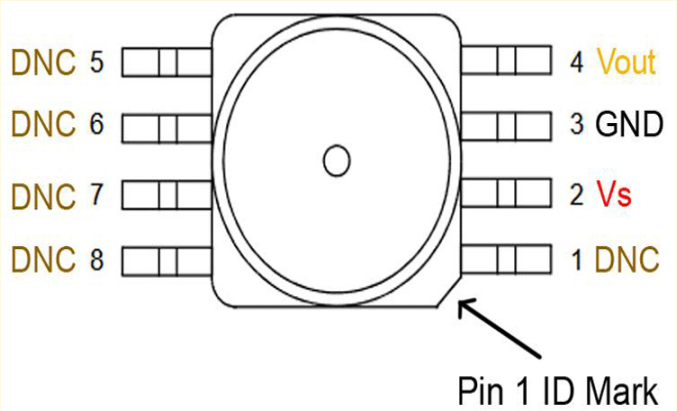
Ultrasonic Sensor



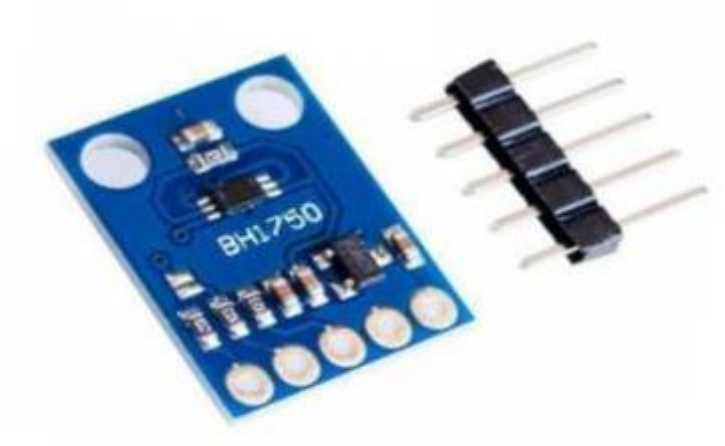
5.3)- Different Types of Sensors

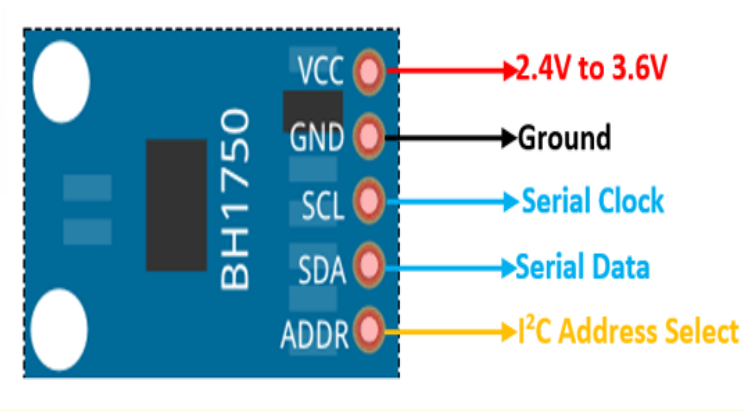
Pressure Sensor



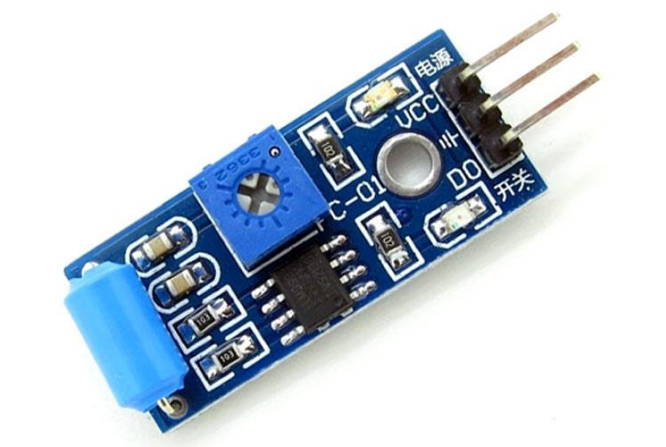


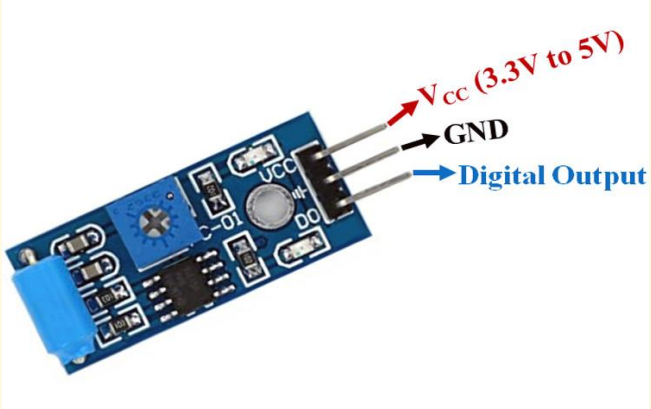
Ambient Light Sensor





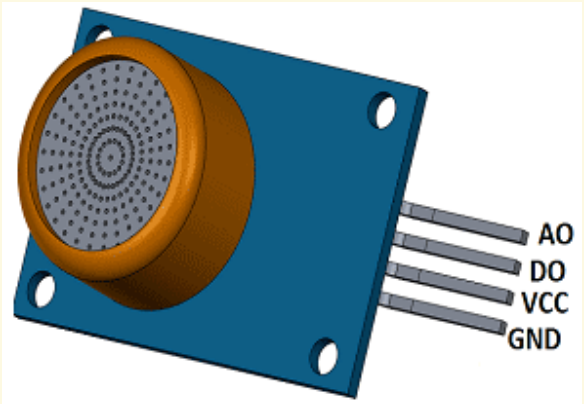
Vibration Sensor



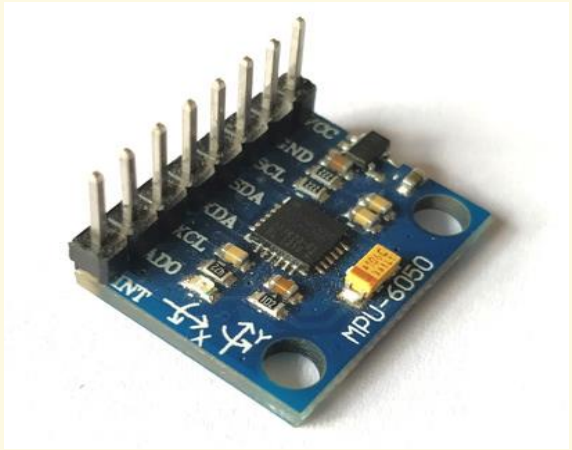


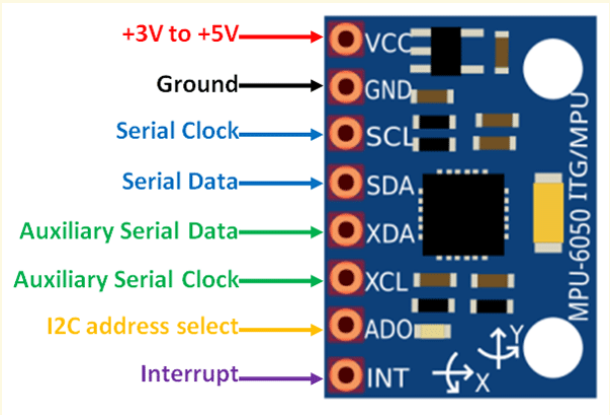
5.3)- Different Types of Sensors

Gas Sensor

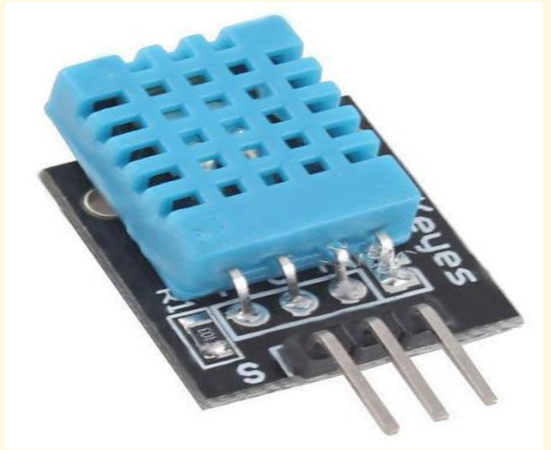


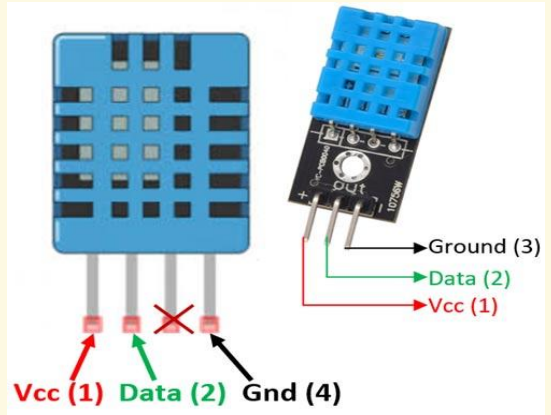
Accelerometer Sensor



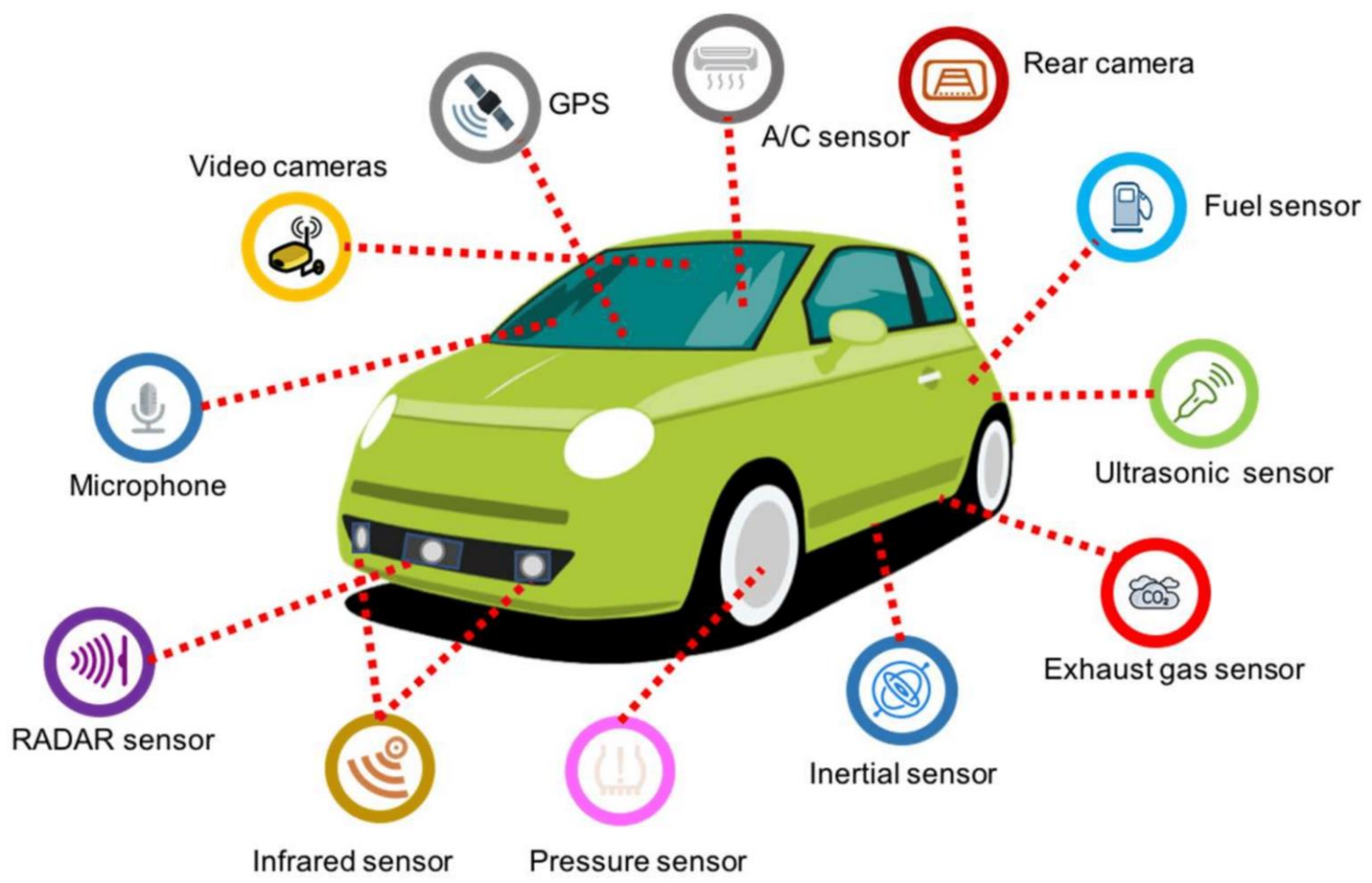


Humidity Sensor





5.4)- Sensor Technologies for Intelligent Transportation Systems

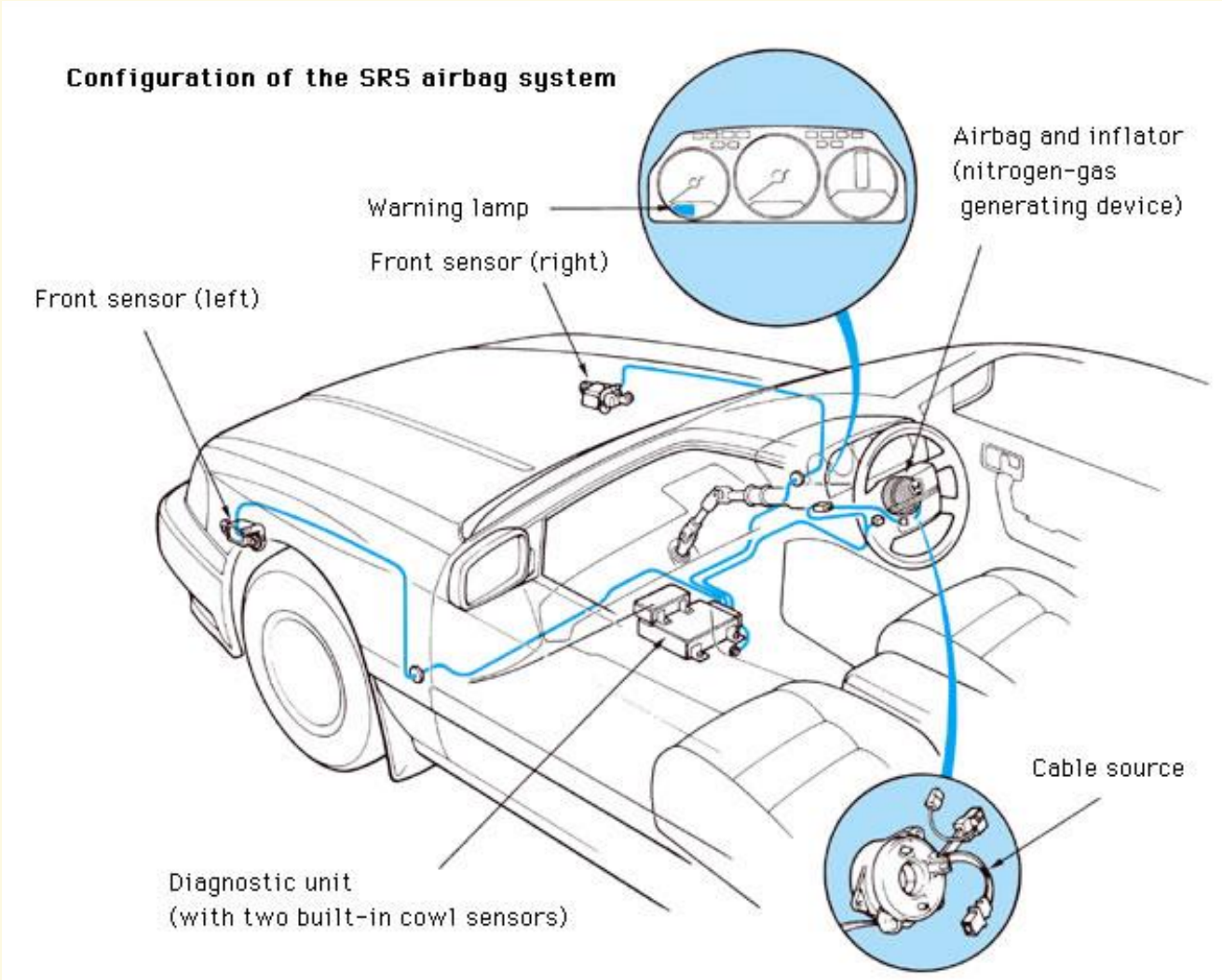


Different types of in-vehicle sensors.

5.4)- Sensor Technologies for Intelligent Transportation Systems

The development team was reorganized under a new objective at the end of 1982.

Their goal was now to enhance the reliability of the airbag system so that it could be produced as an SRS (supplemental restraint system), meaning one supplementing the function of seatbelts.



Thank You for Your Attention

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