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UNIVERSITY OF BISKRA

DEPARTMENT OF TECHNOLOGY

MODULE: TECHNICAL ENGLISH

ENGLISH LECTURE REPORT

Describe a scientific experiment in the field of electrical engineering

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FOR SECOND YEAR STUDENTS LICENCE TECHNOLOGY

Chapter III

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III-1- definition of a scientific experiment:

A scientific experiment is any process in which measurements are used and tests are carried out to verify or refuse a hypothesis. The hypothesis is a proposition that appears to be true, but has not yet been corroborated, and from which an investigation can be developed. Its objective is to increase the data we know about nature.

The scientific experiment belongs to a whole process known as the **scientific method**. This method is a set of ordered steps used to acquire new knowledge on any subject. Their steps are:

1. Making an observation.
2. Asking a question and formulating a hypothesis.
3. Scientific experiments to test the hypothesis and collect data.
4. Examining the results and drawing conclusions.
5. Reporting the results.

III-2- Main types of scientific experiment:

The three main types of scientific experiments are experimental, quasi-experimental, and observational (non-experimental)

– **Experimental**: or randomized control, is the highest level of scientific experimentation. In this form of scientific experiment, at least two groups are used [1].

- **Quasi-experimental:** is the second type of scientific experiment. Its goal is to prove that an independent and dependent variable have a cause-and-effect connection. A quasi-experiment, unlike a true experiment, does not rely on random assignment. Subjects are instead divided into groups depending on non-random factors. In circumstances where true experiments are not possible due to ethical or practical considerations, quasi-experimental design is a useful technique [2].

- **Non-experimental:** research is study in which no independent variable is manipulated. Non-experimental researchers just measure variables as they naturally occur rather than influencing an independent variable (in the labor real world). Non-experimental research is preffered in a variety of situations [3].

III-3- Examples of scientific experiment:

If there is one thing that is guaranteed to get your students excited, it's a good science experiment! While some experiments require expensive lab equipment or dangerous chemicals, there are plenty of cool projects you can do with regular household items. We've rounded up a big collection of easy science experiments that anybody can try, and kids are going to love them!

1. Amplify a smartphone

No Bluetooth speaker? No problem! Put together your own from paper cups and toilet paper tubes.

2. Watch the water rise

Learn about Charles's Law with this simple experiment. As the candle burns, using up oxygen and heating the air in the glass, the water rises as if by magic

3. Set raisins dancing

This is a fun version of the classic baking soda and vinegar experiment, perfect for the younger crowd. The bubbly mixture causes raisins to dance around in the water.

4. Race a balloon-powered car

Kids will be amazed when they learn they can put together this awesome racer using cardboard and bottle-cap wheels. The balloon-powered "engine" is so much fun too.

5. Make elephant-sized toothpaste

This fun project uses yeast and a hydrogen peroxide solution to create overflowing "elephant toothpaste." You can also add an extra fun layer by having the kids create toothpaste wrappers for their plastic bottles

III-4- Electrical engineering definition:

a) - Engineering: is the designing, testing and building of machines, structures and processes using maths and science. Studying it can lead to a rewarding career. Engineering is a discipline dedicated to problem solving

b) - Electrical engineering is a section of physics that deals with the field of electricity and its applications. It brings together the fields of electro technical engineering and electronic engineering. The domain study is carried out in physics; the application is done in the industrial domain.

III-4-1- Best Electrical Engineering Specializations, Devices and Tools:

The electrical devices are depending on electrical energy (AC or DC) to power their main parts (electric motors, transformers, lighting, rechargeable batteries, and control electronics). They can be compared to traditional mechanical devices that rely on different energy sources like fuels or human physical strength. Electronic devices are a specialized type of electrical devices in which electrical energy is primarily used for data processing rather than for the generation of mechanical forces. To better differentiate the two classes, electrical devices that emphasize physical work are also called electromechanical. Mechatronics accentuates the intersection of the two fields. Together, electronic and electrical devices, their development, maintenance and power supply constitute the subject of electrical engineering.

With the advancement in technology, many **electrical engineering specialization fields** have been developed in recent years. This demand is growing in all areas all over the world.

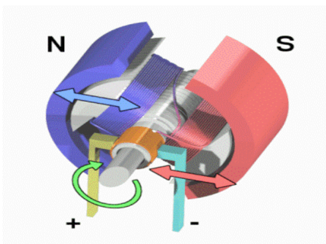
A) - Power and energy:

Power & Energy engineering deals with the generation, transmission, and distribution of electricity as well as the design of a range of related devices. These include transformers, electric generators, electric motors, high voltage engineering, and power electronics. Power engineers may work on the design and maintenance of the power grid as well as the power systems that connect to it. Such systems are called on-grid power systems and may supply the grid with additional power, draw power from the grid, or do both. Power engineers may also work on systems that do not connect to the grid, called off-grid power systems, which in some cases are preferable to on-grid systems [4].

Their devices and tools:

- **Electricity generation** is the process of generating electric power from sources of primary energy. For utilities in the electric power industry, it is the stage prior to its delivery (transmission, distribution, etc.) to end users or its storage
- **Electric power transmission** is the bulk movement of electrical energy from a generating site, such as a power plant, to an electrical substation. The interconnected lines that facilitate this movement form a *transmission network*
- **Electric power distribution** is the final stage in the delivery of electricity. Electricity is carried from the transmission system to individual consumers.
- **A transformer** is a passive component that transfers electrical energy from one electrical circuit to another circuit, or multiple circuits
- **An electric motor** is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and electric current
- **An electrical grid** is an interconnected network for electricity delivery from producers to consumers. Electrical grids vary in size and can cover whole countries or continents.



Generation **Transmission** **Transformers** **Electric motors**

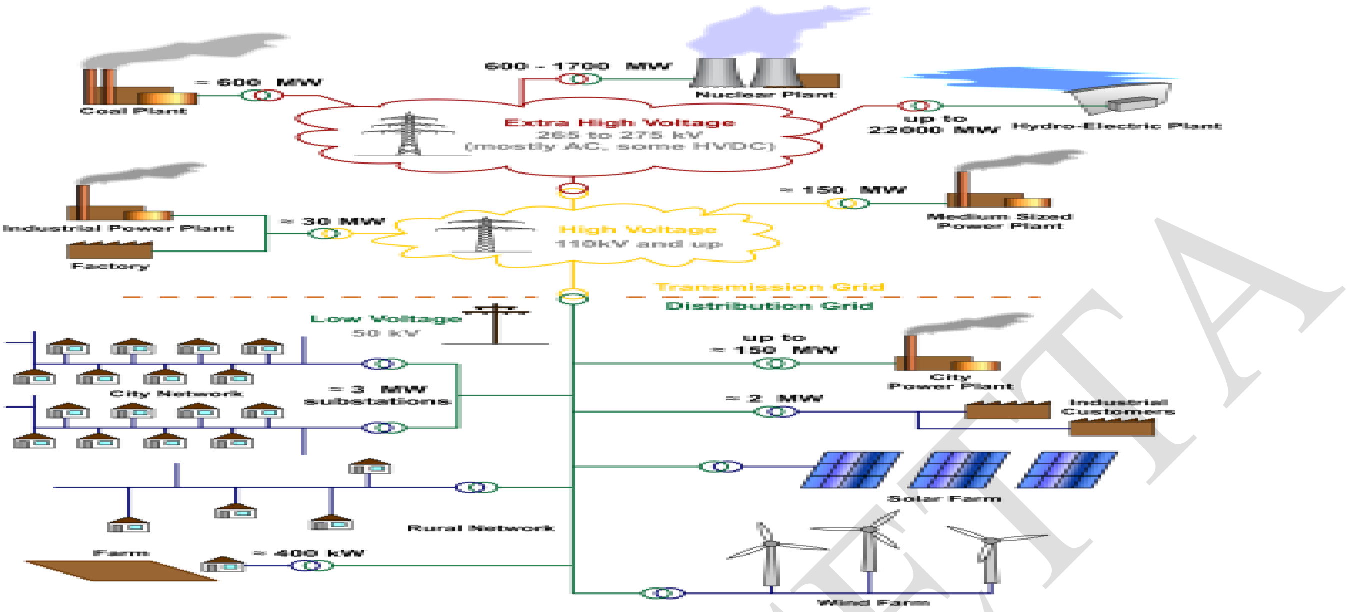


Figure.1: Power grid

B) - Telecommunications:

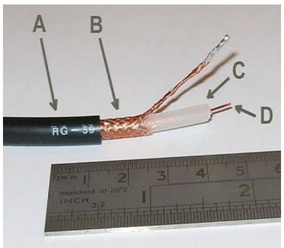
Communications engineering focuses on transmitting information over a communication channel such as coaxial cable, optical fiber, or free space. Free-space transmissions require encoding information into a carrier signal to convert the information to a carrier frequency suitable for transmission; this is known as modification. Common analog modulation techniques include amplitude modulation and frequency modulation. The choice of modification affects the cost and performance of the system and the engineer must carefully balance these two factors [5].

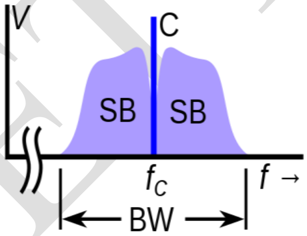
Once the transmission characteristics of a system are determined, communications engineers design the necessary transmitters and receivers for those systems. These two are sometimes combined to form a two-way communication device known as a transceiver. A key consideration in the design of transmitters is their power consumption as this is closely related to signal strength. Normally, if the strength of the transmitted signal is insufficient once the signal reaches the receiver's antenna(s), the information in the signal will be corrupted by noise, especially static data [6].

Their devices and tools:

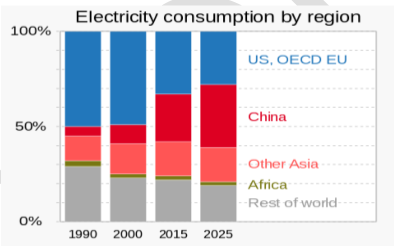
- **transmission** is the process of sending or propagating an analog or digital signal via a medium that is wired, wireless, or fiber-optic
- **Coaxial cable**, or **coax** ,is a type of electrical cable consisting of an inner conductor surrounded by a concentric conducting shield, with the two separated by a dielectric.
- **Free-space optical communication** (**FSO**) is an optical communication technology that uses light propagating in free space to wirelessly transmit data for telecommunications or computer networking.

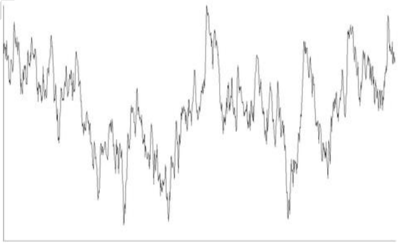
- **Arrier wave**, **carrier signal**, or just **carrier**, is a <u>waveform</u> (usually <u>sinusoidal</u>) that is <u>modulated</u> (modified) with an information-bearing <u>signal</u> (called the *message signal* or *modulation signal*) for the purpose of conveying information.
- **Amplitude modulation** (**AM**) is a <u>modulation</u> technique used in electronic communication, most commonly for transmitting messages with a <u>radio wave</u>.
- **Frequency modulation** (**FM**) is the encoding of <u>information</u> in a <u>carrier wave</u> by varying the <u>instantaneous frequency</u> of the wave. The technology is used in <u>telecommunications</u>, <u>radio broadcasting</u>, <u>signal processing</u> and <u>computing</u>.
- **Signal strength** refers to the <u>transmitter power output</u> as received by a reference antenna at a distance from the transmitting antenna.
- **Noise** is an unwanted disturbance in an electrical signal.





Transmition **Coaxial cable** **Free space** **Carrier signal**





Transmitters **Consumption** **Noise**

C) - Electronics:

Electronic engineering involves designing and testing electronic circuits that use the properties of components such as resistors, capacitors, inductors, diodes, and transistors to achieve a specific function. The tuned circuit, which allows the radio user to filter out all but one station, is just one example of such a circuit. Another example of research is a pneumatic signal conditioner [4].

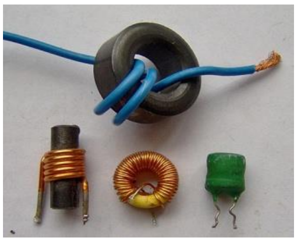
Before World War II, this subject was known as radio engineering and was mainly limited to aspects of communications, radar, commercial radio and early television. Later, in the postwar years, as consumer appliances began to be developed, the field grew to include modern television, audio systems, computers, and microprocessors. In the mid-to-late 1950s, the term radio engineering gradually gave way to the name electronic engineering.

Their devices and tools:

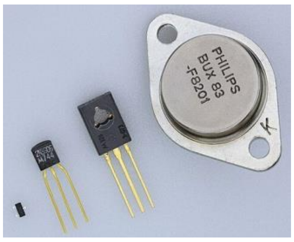
- **An electronic circuit** is composed of individual electronic components, such as resistors, transistors, capacitors, inductors and diodes, connected by conductive wires or traces through which electric current can flow.
- **A resistor** is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses.
- **A capacitor** is an electronic device that stores electrical energy in an electric field by accumulating electric charges on two closely spaced surfaces that are insulated from each other. It is a passive electronic component with two terminals.
- **An inductor**, also called a **coil**, **choke**, or **reactor**, is a passive two-terminal electrical component that stores energy in a magnetic field when electric current flows through it. An inductor typically consists of an insulated wire wound into a coil.
- A **diode** is a two-terminal electronic component that conducts current primarily in one direction (asymmetric conductance). It has low (ideally zero) resistance in one direction and high (ideally infinite) resistance in the other.
- A **transistor** is a semiconductor device used to amplify or switch electrical signals and power. It is one of the basic building blocks of modern electronics
- An **LC circuit**, also called a **resonant circuit**, **tank circuit**, or **tuned circuit**, is an electric circuit consisting of an inductor, represented by the letter L, and a capacitor, represented by the letter C, connected together. The circuit can act as an electrical resonator, an electrical analogue of a tuning fork, storing energy oscillating at the circuit's resonant frequency.
- **Electronic filters** are a type of signal processing filter in the form of electrical circuits. This article covers those filters consisting of lumped electronic components, as opposed to distributed-element filters.
- **A microprocessor** is a computer processor where the data processing logic and control is included on a single integrated circuit (IC), or a small number of ICs. The microprocessor contains the arithmetic, logic, and control circuitry required to perform the functions of a computer's central processing unit (CPU).

Resistors

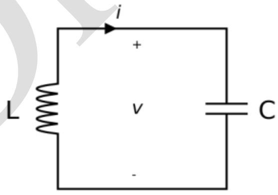
Capacitors



Inductors



Transistors



Tuned circuit

Filter

Microprocessor

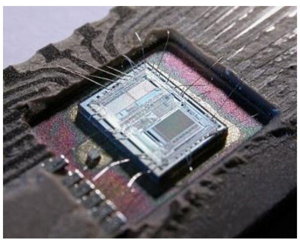
D) - Control engineering and automatic:

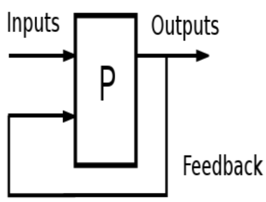
Control engineering focuses on modeling a variety of dynamic systems and designing controllers that will make these systems behave in the desired way. To implement these controllers; electronic control engineers may use electronic circuits, digital signal processors, microcontrollers, and programmable logic controllers (PLCs). It has a wide range of applications from the flight and propulsion systems of commercial aircraft to the cruise control found in many modern automobiles. It also plays an important role in industrial automation [7].

Control engineers also work in robotics to design autonomous systems using control algorithms that interpret sensory feedback to control motors that move robots such as autonomous vehicles, drones, and others used in a variety of industries [8].

Their devices and tools:

- **A digital signal processor** (**DSP**) is a specialized microprocessor chip, with its architecture optimized for the operational needs of digital signal processing. DSPs are fabricated on MOS integrated circuit chips.
- A **microcontroller** (**MC**, **UC**, or **μC**) or **microcontroller unit** (**MCU**) is a small computer on a single integrated circuit. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals.
- **A programmable logic controller** (**PLC**) or **programmable controller** is an industrial computer that has been ruggedized and adapted for the control of manufacturing processes, such as assembly lines, machines, robotic devices.
- **Cruise control** (also known as **speed control**, **cruise command**, **autocruise**, or **tempomat**) is a system that automatically controls the speed of an automobile. The system is a servomechanism that takes over the throttle of the car to maintain a steady speed as set by the driver.
- **Feedback** occurs when outputs of a system are routed back as inputs as part of a chain of cause-and-effect that forms a circuit or loop. The system can then be said to *feed back* into itself.
- **Robotics** is an interdisciplinary field that involves the design, construction, operation, and use of robots.
- **Vehicular automation** involves the use of mechatronics, artificial intelligence, and multi-agent systems to assist the operator of a vehicle such as a car, lorries, aircraft, or watercraft





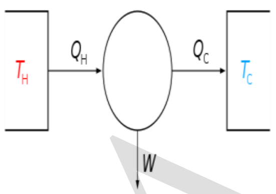
Digital signal processors **Microcontrollers** **PLCs** **Feedback**

E) - Electro technical and Instrumentation engineering:

Instrumentation engineering deals with the design of devices to measure physical quantities such as pressure, flow, and temperature. Designing such instruments requires a good understanding of physics, which often extends beyond electromagnetic theory. For example, flight instruments measure variables such as wind speed and altitude to enable pilots to control the aircraft analytically. Often the devices are not used per se, but instead as sensors for larger electrical systems.

Their devices and tools:

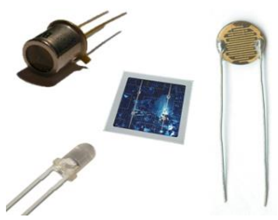
- **Pressure** (symbol: *p* or *P*) is the force applied perpendicular to the surface of an object per unit area over which that force is distributed. Gauge pressure (also spelled *gage* pressure) is the pressure relative to the ambient pressure.
- **Electromagnetism** is an interaction that occurs between particles with electric charge via electromagnetic fields. The electromagnetic force is one of the four fundamental forces of nature.
- **Flight instruments** are the instruments in the cockpit of an aircraft that provide the pilot with data about the flight situation of that aircraft, such as altitude, airspeed, vertical speed, heading and much more other crucial information in flight.
- **Wind flow speed :** is a fundamental atmospheric quantity caused by air moving from high to low pressure, usually due to changes in temperature. Wind speed is now commonly measured with an anemometer.
- **A thermocouple**, also known as a "thermoelectrical thermometer", is an electrical device consisting of two dissimilar electrical conductors forming an electrical junction.
- **A sensor** is a device that produces an output signal for the purpose of sensing a physical phenomenon.



Flow

Flight instruments

thermocouple



Sensors

III-5- Renewable Energy Power Revolution: Latest Trends in Electrical Engineering:

Electrical engineers must address growing problems in the smart and sustainable energy sectors. There is the role of renewable energy, which helps produce electricity in a better way. Renewable energy is becoming more and more in demand all over the world. As opposed to non-renewable energy sources like coal, oil, or gas, its abundant natural availability and lower emissions of carbon and other pollutants are the primary reasons. Renewable energy comes from processes or natural resources that are constantly replenished. Hydro, biomass, geothermal, and wave energy are the other types of renewable energy [10].

Renewable is becoming a more significant power source. From residential rooftop solar panels to enormous offshore wind farms, the growth of renewable energy is also taking place on both large and small scales. Heating and lighting are both provided by renewable sources in some rural communities.

III-5-1- What Is Renewable Energy?

Renewable energy is energy that has been derived from earth's natural resources that are not finite or exhaustible, such as wind and sunlight. Renewable energy is an alternative to the traditional energy that relies on fossil fuels, and it tends to be much less harmful to the environment.

III-5-2- Types of Renewable Energy:

1- Solar energy

Solar energy is derived by capturing radiant energy from sunlight and converting it into heat, electricity, or hot water. Photovoltaic (PV) systems can convert direct sunlight into electricity through the use of solar cells.

Solar technologies are used by industries and businesses to save money, increase efficiency, and diversify their energy sources. Solar photovoltaic and solar power technologies are utilized by energy developers and utilities to produce electricity on a massive scale. The electricity grid is being modernized by renewable energy, making it smarter, safer, and interconnected across regions.

2- Wind energy

Wind farms capture the energy of wind flow by using turbines and converting it into electricity. There are several forms of systems used to convert wind energy and each vary. Commercial grade wind-powered generating systems can power many different organizations, while single-wind turbines are used to help supplement pre-existing energy organizations. Another form is utility-scale wind farms, which are purchased by contract or wholesale. Technically, wind energy is a form of solar energy. The phenomenon we call "wind" is caused by the differences in temperature in the atmosphere combined with the rotation of Earth and the geography of the planet. [10]

3- Hydroelectric energy

Dams are what people most associate when it comes to hydroelectric power. Water flows through the dam's turbines to produce electricity, known as pumped-storage hydropower. Run-of-river hydropower uses a channel to funnel water through rather than powering it through a dam.

4- Geothermal energy

Geothermal heat is heat that is trapped beneath the earth's crust from the formation of the Earth 4.5 billion years ago and from radioactive decay. Sometimes large amounts of this heat escapes naturally, but all at once, resulting in familiar occurrences, such as volcanic eruptions and geysers. This heat can be captured and used to produce geothermal energy by using steam that comes from the heated water pumping below the surface, which then rises to the top and can be used to operate a turbine.

5- Hydrogen and fuel cells energy

Hydrogen needs to be combined with other elements, such as oxygen to make water as it does not occur naturally as a gas on its own. When hydrogen is separated from another element it can be used for both fuel and electricity.

6- Biomass energy

Bio-energy is a renewable energy derived from biomass**.** Biomass is organic matter that comes from recently living plants and organisms. Using wood in your fireplace is an example of biomass that most people are familiar with.

Figure.2: Department of Electric Power Engineering

III-5-3- Most Energy Power Trends in Electrical Engineering:

1. The transmission of electrical energy without the use of connecting wires from a power source to a receiver is referred to as wireless power transfer (WPT) or wireless energy transfer. For energy transmission, WPT systems make use of time-varying electromagnetic fields. Heart pumps, security software, and electric vehicle charging docks have all been mentioned as possible applications for wireless power transfer.
2. Smart grids and micro grids promise a better and more cost-effective approach to power generation, in line with current industry trends [11].

- In order to better manage the delivery of electricity and respond to shifting demand, smart grids use two-way communication between the utility and the customer. In addition, renewable energy sources and storage technologies can benefit from this development in electrical engineering. Customers can sell excess current and generate their own power with smart grids.
- A micro grid is a single, controllable entity with respect to the grid made up of interconnected loads and distributed energy resources. On the other hand, to lay it more plainly, micro grids are independent power sources that give capacity to more modest, local area-based regions. Micro grids permit networks to create power nearby when they need

it. The current infrastructure for the delivery of electricity could be altered by this trend in power generation.

Figure.3: Smart Grid Requires Re-engineering of the Electricity Industry

3. The electrical design of electric vehicles follows a trend that keeps gaining popularity among consumers. Electric vehicles are becoming increasingly common. Even though charging infrastructure needs to be built, many electric vehicle owners can find charging stations that are easy to get to in many places. Wireless charging will soon be a standard feature on electric vehicles. Drivers can park their cars in a wireless charging location without the requirement for an external connection, in place of huge charging docks. Engineers are able to achieve their full potential by comprehending and analyzing current and future trends. The future is far more fascinating, innovative, and competitive; electrical engineers at Top Engineering College in Coimbatore have a lot on their desks today and will have a lot more in the future.

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