1 WAVE MOTION

WAVE

- **Wave motion** is the propagation of disturbances, produced on one part of a medium by the vibration of its particles, to all its other parts.

Wave motion are two types:

- Mechanical waves and Electromagnetic waves.

Mechanical waves:

- Example: Sound, water waves. Need a medium

Electromagnetic Waves:

- Example: Light, Radio Waves. Medium is not essential.

Mechanical waves are two types:

- Transverse wave and Longitudinal wave.

Transverse wave:

- The particles of the medium vibrate perpendicular to the direction of propagation of the wave.
- Crests and troughs are formed. Formed on the surface of liquids and solids.

Longitudinal wave:

- The particles of the medium vibrate parallel to the direction of propagation of the wave.
- Compressions and Rarefactions are formed.
- Formed inside the solids, liquids and gases.

CHARACTERISTICS OF WAVE

- **Amplitude:** It is the maximum displacement of a particle from its mean position. Unit metre(m)
- **Wavelength (λ) :** The distances between two nearest points in a wave are in same phase of vibration. Unit-metre(m)
- **Frequency (f) :** The number of vibration per second. Unit-Hertz(Hz)
- **Velocity (v) :** It is the distance travelled by a wave in one second. Unit-(m/s)

Relation between λ, f and v

$$v = f\lambda \quad \text{or} \quad f = \frac{v}{\lambda} \quad \text{or} \quad \lambda = \frac{v}{f}$$

SOUND

- Sound needs a material medium

Medium	Velocity (m/s)
Aluminium	6420
Steel	5941
Pure water	1482
Sea water	1522
Air	343
Helium	965

- The sound waves are longitudinal waves.
- The velocity of sound is different in different mediums due to its density.

Factors influencing the speed of sound through air are:
Humidity, Density, Pressure, Temperature and Wind.

- Humidity is the amount of water vapor in the air.
- During cold winter days humidity is low.
- In the summer days humidity is high.
- Speed of sound increases with humidity
- The density of air decreases with the increase in humidity.

Natural frequency

- It is the frequency at which an object vibrates freely.

Natural vibration

- The free vibration of an object is called Natural vibration.
- If an object is allowed to vibrate freely, the object should vibrate in its own natural frequency.

Forced vibration

- A body undergoing vibration under the influence of a vibrating body with the same frequency as that of the influencing body, it is called forced vibration.

RESONANCE

- Sonometer and Resonance column are used in laboratory for explain resonance.

Sonometer:

- **Working:** Bring the bridges of a sonometer close to each other. Put a paper rider on the string between the bridges. Excite a tuning fork and press its stem on to the sonometer board. When the distance between the bridges became a particular length, the bridges is forced to vibrate at a frequency of tuning fork. Due to resonance the wire may start vibrating violently and the paper rider thrown away from the wire.
- If the natural frequency of a body undergoing forced vibration is the same as that of the forcing body, then they are said to be in resonance.

Resonance of air columns:

- When the natural frequency of tuning fork and air column is equal, they are said to be in resonance. Now the loudness increases due to the increase in the amplitude.

Practical effects of resonance

- Soldiers cannot march through a hanging bridge
- The doors and windows of nearby buildings vibrate at the time of firework.
- When we talk near instruments of violin, guitar etc. its string vibrates.

REFLECTION

- Sound bounce back when it falls on hard surface is reflection
- Sound getting reflected repeatedly from different bodies is called multiple reflections.
- Megaphones, Horns, Stethoscope, Sound board are utilizing multiple reflections.

Reverberation

- The persistence of sound as a result of multiple reflection is reverberation

Persistence of Hearing

- The sensation of hearing produced by sound is retained for a period of 1/10 second. This peculiarity of the ear is persistence of hearing.

ECHO

- The phenomenon of hearing a sound by reflection from a surface or obstacle, after hearing the original sound.
- The distance from the sound reflecting surface to hear an echo should be above 17m

Acoustics of buildings

- Acoustics of buildings is the branch of science which deals with the conditions to be fulfilled in the construction of a hall for clear audibility.

Seismic Waves

- Waves travelling through layers of the earth due to big explosion, earthquakes and volcanic explosion.
- Seismology is the branch of science that deals with study of seismic waves.

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2 EFFECTS OF ELECTRIC CURRENT

HEATING EFFECTS OF ELECTRIC CURRENT

- Electric iron, electric heater, electric bulb etc. are the appliances working on the heating effect of electricity.
- Two small pieces of thin copper wire and nichrome wire of nearly equal length and thickness, then the resistance of the nichrome wire is greater than that of copper wire.
- Copper wire and nichrome wire are connected in series, then the current passing through them are same.

The factors affecting the heat produced

- Electric current
- Resistance of the conductor
- Time of flow of electric current

JOULE'S LAW

- The heat produced by an electric current flowing through a conductor is equal to the product of the square of current passed, the resistance of the conductor and time for which the current is passed.

- Heat: $H = I^2Rt$; $H = VIt$; $H = \frac{V^2t}{R}$; $H = Pt$
- I=Current, R=Resistance, V=Voltage, t=Time, P=Power

HEATING DEVICES

- It is an electrical device that convets current to heat
- Heating coil (Main part)
- Heating coils are made of Nichrome
- Nichrome is an alloy of nickel, chromium, iron and manganese.

Characteristics of Nichrome:

- High melting point and resistivity, ability to remain in red hot state for a long time.

Appliances	Energy change
Electric iron	electrical energy is converted into heat energy
Electric fan	electrical energy is converted into mechanical energy
Electromagnet	electrical energy is converted into magnetic energy
Electric heater	electrical energy is converted into heat energy

SAFETY FUSE

- It is a device that works on the heating effect of electric current.
- **The Main Part:** Fuse wire
- **Fuse wire:** Alloy of tin and lead (Low melting point)
- Safety fuse is a mechanism to safe electrical appliances by stopping huge current due to short circuit or overloading in a circuit.
- When an excessive current flows through it, the wire melts and the circuit is broken.

LIGHTING EFFECTS OF ELECTRIC CURRENT

Incandescent lamp (Filament lamp)

- Main part → Filament, Filament is made of tungsten.
- **Characteristics of tungsten:** High melting point and resistivity, ability to remain white hot for a long time.
- **Working:** Heat is produced when current flows through the tungsten filament and produces white light.
- The presence of inert gases with low pressure in the incandescent bulb helps to reduce the evaporation of the filament.
- Major part of energy supplied filament lamp is lost as heat.

Discharge Lamps

- **Main parts:** Two electrodes, a glass tube filled with gas
- **Working:** When current is passing through through discharge lamp, the electrons ionises the gas inside the tube. As a result of the collision of ions and electrons with unionized particles and produces light.
- The colour of light depends in gas

(Neon-Orange red; Nitrogen-Red ; Sodium-Yellow; Mercury-White; Chlorine-green; Hydrogen-Blue)

Fluorescent Lamps

- **Working:** The electrons ionize mercury atoms, ultraviolet rays are produced. These rays are absorbed by the fluorescent materials and produce visible light.
- **Merits:** High longevity (five times that of filament lamp), Shadow minimized, Energy loss is less, Gives greater intensity of light.
- Ultraviolet rays along with blue light are produced by some lamps and are used as traps for flies and in banks for detecting fake notes.

CF lamps

- A CFL has a unit of electronic circuit and fluorescent tube containing mercury vapour.
- The working of CFL is similar to fluorescent lamp and fluorescent tube connected with electronic circuit.

LED Lamps

- A very low power is enough for LED lamps.
- No loss of energy in the form of heat (No filament).
- It is not harmful to environment (No mercury).

Arc Lamps

- Parts of an Arc Lamp:
  - Two carbon rods
  - A concave mirror
  - An electric source from 40V to 60V.
- Carbon rods kept at a fixed distance in an evacuated glass tube. Electric discharge produced when a high voltage is applied between them gives bright light to the arc lamp.

POWER

- The amount of energy consumed by an electrical appliance in unit is its power.
- Power is the rate at which work is done. Unit: Watt
- $\text{Power} = \frac{\text{Work}}{\text{time}}$ $P = I^2R$; $P = VI$; $P = \frac{V^2}{R}$

3 ELECTROMAGNETIC INDUCTION

MAGNETIC FLUX

- Keeping the solenoid at rest bring one end of a magnet moves towards the solenoid and then take it back at the same speed. The needle deflects and suddenly comes back to the initial position.

- The magnetic flux associated with a coil changes by the relative motion of the coil or magnet.

Electromagnetic Induction

- Whenever there is a change in magnetic flux linked with the coil, electricity is induced in the coil. This phenomenon is called electromagnetic induction.
- The emf developed due to electromagnetic induction is called induced emf
- The current obtained due to electromagnetic induction is called induced current.

Fleming's Right hand rule

- Stretch the thumb, fore finger and middle finger of the left hand so that they are perpendicular to one another. The fore finger represents the direction of the magnetic field, the middle finger represents the direction of the induced current, and the thumb indicates the direction of the motion of conductor, This is Fleming's right hand rule.

AC and DC

Alternating Current (AC):

- The direction of current changes at regular intervals of time.

Direct Current (DC):

- A current that flows only in one direction.

GENERATORS

- The device which produces electricity on the basis of electromagnetic induction by the continuous motion of either the solenoid or the magnet is called a **generator.**

AC generator

- Generator gives alternating current.
- Main parts:
  - **Field magnet:** This is the magnet which produces magnetic flux in a generator.
  - **Armature:** An armature is an arrangement of insulated copper wire wound on a soft iron core.
  - **Slip rings:** They are full rings fused to the ends of the armature coil.
  - **Brushes:** An arrangement that is always in contact with the slip rings
- **Working:** When the armature rotates in the magnetic field, an alternating emf is induced in the coil. The current is carried to the external circuit through the brushes keeping contact with the slip rings.
- **Different stages of the rotation of the armature:** During the first half of rotation the current begins from zero and reaches the maximum positive value, then decreases gradually and comes to zero. In the second half, the current reaches the maximum negative value, then decreases gradually and reaches zero.
- As a result of variation of the magnetic flux linked with a conductor, a current is induced in it, the direction of which changes continuously. This is known as alternating Current (AC).

- The induced current developed in one direction during the first half rotation of the armature of the AC generator and the induced current developed in the opposite direction during the next half of the rotation constitute one cycle of an AC.
- The number of cycles in one second is called the frequency of AC.
- The frequency of AC in our houses is 50 Hz.

POWER GENERATOR

- The centres where electric power is generated for large scale distribution are called power houses or **power stations.**
- Mainly Three Parts.
- Rotor : The rotating part (Field magnet)
- Stator : Stationary part (Armature)
- Excitor: (Auxiliary Generator): (Providing DC to electromagnets in large AC generators)
- The armature of a power generator will be heavy and so it is used as the stator. This helps to eliminate the graphite brush and avoid sparks.

The problems when a permanent magnet is used as the field magnet.

- The limitation of producing strong magnets.
- The magnetic strength of permanent magnet loses gradually. So the flex cannot be maintained stable.
- The strength of the field magnet cannot be increases or decreases.

Single phase Generator

- One Field magnet and One Armature Coil.Only a single Ac is obtained
- It is used in House and Shops

Three Phase Generator

- One Field magnet. Three Armature Coil. Three distinct AC is obtained
- It is used in Power station
- Numbers of turns are equal in three armature coil.
- Permanent magnet is used as the field magnet.
- The frequency of the AC will be the same in each armature coil.
- Three identical armature coil at angle of 120^0 with one another. If each end of the three armature coils is made to meet at a common point. This point is called the **neutral point.**
- If a person touches the neutral line he will not get electric shock because the potential difference between the neutral line and the earth is zero.

Moving coil microphone

- In moving coil microphone, the voice coil remains in the magnetic gap of a powerful magnet. The voice coil vibrates with the vibrations of the diaphragm when sound waves fall on it. The movement of the voice coil across the magnetic field induces an electric current in the coil. The intensity of the current varies in accordance with the variations of sound waves falling on the diaphragm.
- When the intensity of sound produced in front of the diaphragm increases; the amplitude of the induced electric signal formed in the coil also increases.

- In moving coil microphone sound energy is converted into electrical energy

MUTUAL INDUCTION

- A magnetic field is generated around the primary solenoid when an electric current is passed through it by connecting the ends of the solenoid to a battery cell. But induced emf is not produced in the secondary solenoid as there is no change in this magnetic flux. When the switch is on and off the flux linked with the secondary coil changes and thus an emf is induced in the secondary coil. Here AC is passed through the primary coil. The direction of ac changes at regular interval continuously. As the secondary coil is located at this magnetic field which changes at regular interval continuously, the change in flux causes the production of an induced emf in the secondary coil continuously. So the bulb glows continuously.
- If the number of turns of the secondary is more than the number of turns of the primary the induced emf increases and if the number of turns of the secondary is less than the number of turns of the primary the induced emf decreases.
- When there are two nearby coils the variation of current in one of them produces a change in the magnetic flux around it and an emf is induced in the secondary coil.

TRANSFORMER

Transformer are two types:

Step up transformer	Step down transformer
Increases AC voltage	Decreases AC voltage
Number of turns is less and thick wire is used in primary	Number of turns is large and thin wire is used in primary
Number of turns is large and thin wire is used in secondary	Number of turns is less and thick wire is used in secondary
In primary Current is large and Voltage less	In primary Current is less and Voltage large

$$\frac{V_s}{V_p}=\frac{N_s}{N_p} \quad ; \quad \frac{I_p}{I_s}=\frac{V_s}{V_p} \quad ; \quad \frac{I_p}{I_s}=\frac{N_s}{N_p}$$

SELF-INDUCTANCE

- The change in magnetic flux in a solenoid or conductor will generate a back emf.
- The effective voltage is reduced through a conductor due to back emf.

Inductors

- Inductors are coil which can oppose the changes of current in a circuit.

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4 GENERATION AND DISTRIBUTION OF ELECTRIC POWER

POWER STATION

Hydroelectric power station

- Hydroelectric power stations are power stations where electricity is produced by rotating turbines of a generator by allowing water stored at a height to flow through penstock pipe.

- Mechanical energy → Electrical energy
- Example:Moolamattam,Pallivasal,Kuttiadi,Sabarigiri.

Thermal Power station

- In thermal power station the heat energy released during the burning of fuels like naphtha, coal and lignite is used for heating water and producing steam at high pressure. The steam thus produced is used for rotating turbines and generate electricity
- Chemical Energy → Thermal Energy → Mechanical Energy → Electrical Energy
- Example: Kayamkulam, Neyveli, Ramagundam, Brahmapuram.

Nuclear Power station

- In nuclear power station the heat energy released during nuclear fission is used for heating water and producing steam at high pressure. The steam thus produced is used for rotating turbines and generate electricity
- Nuclear Energy → Thermal Energy → Mechanical Energy → Electrical Energy
- Example: Kalpakkam, Tharapur, Kotta, Narora, kudankulam.

POWER TRANSMISSION AND TRANSMISSION LOSS

- Power transmission is the process of sending electricity to distant places through wires from the power station.
- In our country electricity is generated in 11 kV.
- Step up transformers are used at the substation near the powerhouse.
- In other stages of distribution step-down transformer is used.

Problems related to the Transmission (Transmission loss)

- Voltage drop and energy loss

Transmission loss minimized

- By raising the voltage during transmission
- By reducing strength of electric current
  (Reason: The heat produced in a conductor is directly proportional to the square of current passed $H \alpha I^2$)
- Use low resistance material.

- **Power grid:** The different power generating centres and distribution systems are connected by a network.

STAR CONNECTION

- It is a mechanism to send electricity from distribution transformer to house
- 4 lines (3 phase + One neutral)
- Three phase line are connected to a point is called neutral.
- The line starting from this point is neutral line.
- The voltage of this line is zero.
- Potential difference between Two phase line is 400V
- Potential difference between phase line and neutral line is 230V

- Potential difference between neutral line and earth is 0V
- Potential difference between phase line and earth is 230V

HOUSEHOLD WIRING

- The different electrical appliances that are usually used in our houses works at 230V.
- Bulbs connected in parallel circuit are brighter.
- In parallel circuits, if one bulb stops working, then all other bulbs keep working normally. But in series circuit if one bulb stops working, then all other bulbs also stop working.

Advantages of parallel circuits in domestic wiring are

- In parallel circuits, if one electrical appliance stops working then all other appliances keep working normally.
- Each appliance has its own switch due to which it can be turned on or off independently, without affecting other appliances.
- Each appliance gets the same voltage.
- The overall resistance of the circuit is reduced due to which the current from the power supply is high
- Connect in parallel of the order

  Watt Hour meter → main fuse → main → switch → fuses → switches appliances
- Fuse is connected to the phase line.
- The switches are connected to the phase line
- In house all appliances are connected in parallel to neutral line through switches

Measurement of electrical energy

- In our house watt hour meter is the device which connects the electric lines first.
- The instrument which is used for measuring electrical energy consumed is the **watt hour meter**.
- It is connected at the beginning of the electric circuit.
- The energy consumed by a device of power 1000W in one hour is called **Kilowatt hour.**
- It is the commercial unit of electricity.

THREE PIN PLUG AND TWO PIN PLUG

- The line that comes in contact with pin E is the earth line.
- It is thicker and longer than the other two.
- This line is connected to the metallic covering of the appliance.
- The phase and neutral lines are connected to the heating coil of the electric iron.
- When the phase line comes in contact with the outer metallic case the current will flow to the earth.

First aid in the case of electric shock

- First aid should be given only after disconnecting the victim from the electric wire.

FIRST AID

- Raise the temperature of the body by massaging.
- Give artificial respiration.
- Massage the muscles and bring them to the original condition.
- Start first aid for the functioning of the heart (Apply pressure on the chest regularly)
- Take the person to the nearest hospital immediately.

5 HEAT

KINETIC THEORY

- At any state of a substance, their molecules are always in a state of motion. Hence they possess kinetic energy.

Solids	Liquids	Gases
High Intermolecular force	Medium Intermolecular force	Low Intermolecular force
Difficult to move	The molecules can move	The molecules can move easily

- When any substance is heated, the speed of molecule in it increases.

HEAT AND TEMPERATURE

- The total kinetic energy of the molecules in a substance is called **Heat**
- The average kinetic energy of the molecules in a substance is called **Temperature**
- SI Unit of temperature: Kelvin (K)
- Normally temperature is measured in degree celsius (^oC).
- The heat flows from one point to another due to the difference in temperature.
- The unit of heat is joule (J). The unit calorie is also used. 1 calorie = 4.2 joule (approximately).

Mercury Thermometre

- Normally celsius thermometer is used for measuring temperature.
- In mercury thermometers the melting point of ice is marked as 0^oC and the boiling point of water is marked as 100^oC.
- The range from 0^oC to 100^oC is divided into 100 equal parts.

Clinical thermometer

- Usually a clinical thermometer is used to measure the temperature of human body.
- In clinical thermometers Fahrenheit scale is used.
- According to Fahrenheit scale the melting point of ice is 32^oF and the boiling point of water is 212^oF.
- The range from 32^oF to 212^oF is divided into 180 equal parts.
- The relationship between the Celsius scale and Fahrenheit scale.

$$C = \frac{5}{9}(F - 32) ; F = \frac{9}{5}C + 32$$

Kelvin scale

- The kinetic energy of molecules becomes zero at 0K (-273°C).
- This temperature is the absolute zero. The melting point of ice is 273 K.
- Unit difference in temperature is the same in both Celsius scale and Kelvin scale.
- The relationship between Celsius scale and Kelvin scale
  $T = t + 273$, T-Temperature in Kelvin, t-Temperature in Celsius

SPECIFIC HEAT CAPACITY

- Difference in temperature , mass , Nature of substances are the factors influence the quantity of heat supplied to an object when heated.
- The heat energy required to raise the temperature of a substance by 1 K is the heat capacity of that substance. Its unit is $\frac{\text{Joule}}{\text{Kelvin}} = \frac{\text{J}}{\text{K}}$
- The heat energy required to raise the temperature of a substance of mass 1kg by 1K is the specific heat capacity of that substance.

$$\text{Specific heat capacity} = \frac{\text{The amount of heat energy given}}{\text{Mass} \times \text{increase in temperature}}$$

$$\text{Unit} = \frac{\text{joule}}{\text{kilogram} \times \text{kelvin}} = \text{J kg}^{-1}\text{K}^{-1}$$

Substance	Specific heat J $kg^{-1}K^{-1}$	Substance	Specific heat J $kg^{-1}K^{-1}$
Aluminium	900	Ice	2130
Iron	460	Silver	234
Copper	385	Mercury	138
Water	4200	Coconut oil	2100

- Water has the highest specific heat capacity.

Merits:

- *It is because of the high specific heat capacity of water that small changes in the atmospheric temperature don't affect their body quickly.*
- *Water is used in the radiators of vehicles. Even though water receives a lot of heat from the engine, due to its high specific heat capacity the temperature of water does not change much.*
- *Specific heat capacity of water is five times that of sand. So during day time land gets heated fast and the sea gets heated slowly. But during night land cools fast and sea slowly. As a result of this sea breeze occurs during day time and land breeze during night.*
- The quantity of heat needed to raise the temperature of 1kg of water by 1K and that for 1 kg of coconut oil are different.
- If the mass of a substance is m and its specific heat capacity is C then the quantity of heat required to raise the temperature of the substance by θK is

$$Q = mc\theta$$

Principle of method of mixtures

- When a hot body is in contact with a cold body, heat flows from the hot body to the cold body, till both the bodies attain the same temperature. The heat lost by the hot body = heat gained by the cold body. This is the principle of method of mixtures.

CHANGE OF STATE

- The heat received during the change of state is used for increasing the potential energy of molecules in the substance. Hence the temperature does not change.
- The fixed temperature at which a solid changes into its liquid state under normal atmospheric pressure is the melting point. A liquid changes into its solid form at the same temperature. This temperature is its freezing point. Both these are equal.

Latent heat of fusion

- Latent heat of fusion (L_f) of a solid is the quantity of heat absorbed by 1 kg of the solid to change into its liquid state at its melting point without change in temperature.

Substance	Melting point (°C)	Latent heat of fusion J/kg
Ice	0	5×10^3
Silver	962	88×10^3
Copper	1083	180×10^3

VAPORISATION

- The boiling point of a substance is the fixed temperature at which a liquid boils and changes into its gaseous state at normal atmospheric pressure.
- Vaporisation is the process by which a liquid changes into its gaseous state at its boiling point.
- Latent heat of vaporisation (L_v) of a substance is the quantity of heat absorbed by 1 kg of the liquid to change into its gaseous state at its boiling point without change in temperature.

Substance	Boiling point	Latent heat of vaporization (J/kg)
Methanol	64°C	112×10^4
Ethanol	79°C	85×10^4
Mercury	357°C	27×10^4
Water	100°C	22×10^4

- **Evaporation** is the process by which a liquid changes into its vapour form by absorbing heat from the surroundings. This is a normal process that takes place on the surface of the liquid at all temperatures.
- During evaporation the substance which supplies heat gets cooled.
- **Factors that influence the rate of evaporation:**

  Nature of substances, Atmospheric temperature, Wind, surface area.

  Situations where evaporation is utilised:

  Water taken in an earthen pot is cooler. Wet clothes dry quickly if spread out. Blowing of wind causes cooling during perspiration.

GLOBAL WARMING

- Global warming is the phenomenon by which the temperature of the earth's surface and the atmosphere increases due to excess of greenhouse gases.

- Greenhouse gases : CO_2, Methane

Ways to prevent global warming:

- Avoid the excessive use of fossil fuels.
- Reduce the use of CFC (Chloro fluoro carbon).
- Reduce the further production of greenhouse gases.
- Find out an effective method to use hydrogen as a fuel.
- Use non-conventional sources of energy to the maximum for our energy needs.

6 OPTICAL PHENOMENA

DISPERSION OF LIGHT

- Any light that is composed of more than one colour is a composite light.
- Dispersion is the phenomenon of splitting up of a composite light into its constituent colours.
- The regular array of colours formed by dispersion is the visible spectrum.
- The component colours in the composite light deviate at different rates according to their wavelength; this is the reason for dispersion.
- The shortest wavelength – violet
- The longest wavelength – red
- Violet colour – deviates the most due to dispersion
- Red colour – deviates the least due to dispersion

RAINBOW

- The dispersion of light in water forms rainbow.
- The rainbow is seen in the east – morning
- The rainbow is seen in the west – evening
- Sunlight, when it passes through water droplets, undergoes refraction and internal reflection.
- The light ray entering to a drop of water undergoes two refraction and one total internal reflection.
- All the water droplets of the same colour appear to be in the same arc of a circle.
- The outer edge of a rainbow – red.
- The inner edge of a rainbow – violet.

Recombination of colours

- In the first prism white light undergoes dispersion and split into constituent colours. When these constituent colours enter into the second prism get retraced and again change into white by the recombination of colours.

Persistence of vision

- The sensation of seeing an object remains for about 1/16 of a second after the object is removed from view.

Newton's colour disc

- When the Newton's colour disc was rotated at high speed it appeared white.

- Due to the persistence of vision:
  - Newton's colour disc appeared white.
  - A torch rotated rapidly appears as an illuminated circle.

PRIMARY COLOURS

- Green, red and blue are called primary colours.
- Three colours green, red and blue super impose appears white.
- Primary colours cannot be obtained by mixing other colours.
- The colours formed by the combination of any two primary colours are secondary colours.

Complementary colours

- The pair of colours combined with a primary colour to get white light is called complementary colours.

Colours	Secondary colour
Green + red	yellow
Green + blue	cyan
Blue + red	Magenta

Primary colour	Complementary colour
green	Magenta
red	cyan
blue	yellow

Opaque objects

- An opaque object reflects only its colour. It absorb all other colours falls on it.
- A white object does not absorb any colour. It reflects all the colours falling on it. An opaque object that absorbs all the colours of the white light that fall on it will be seen as black. It does not reflect any colour.

Transparent objects

- The colour of a transparent object depends upon the colour that it allows to pass through it.
- A transparent material appears in the colour of the light it transmits. If a transparent material transmits all the colours in white light, it will not have any colour. Water is colourless.

SOLAR SPECTRUM

- All the radiations in the sunlight, are a part of a wide spectrum known as electromagnetic spectrum.

Electromagnetic spectrum

Infrared:

- Comes out from hot objects due to the vibrations of the molecules in them.
- Makes sunlight hot
- Used in remote control and night vision camera

Visible light

- Causes sense of vision
- Helps to produce energy by photo synthesis
- Used in the solar cells

Ultraviolet

- Absorbed by the ozone layers

- Helps to produce vitamin D in the skin
- Likely to cause skin cancer
- Affects vision if exposed to excess radiation

X-ray

- Penetrates through flesh
- Helps to detect defects of bones, breakage of pipes in industrial concerns etc.
- Dissociates DNA, hence excessive exposure causes cancer

Gamma rays

- Causes damage to living cells
- Comes out in large quantities during nuclear fission
- Used in cancer treatment
- Useful in sterilizing surgical instruments

Radio waves

- Used for very high frequency radio transmission.
- Used for ultra-high frequency television transmission.

Microwaves

- Used in radar and mobile phone
- Used in microwave oven

SCATTERING OF LIGHT

- Irregular and partial reflection of light is scattering.
  (When light falls on rough surface or on tiny particles in the atmosphere, it reflects into all directions)

Scattering and wavelength

- Red has practically greater wavelength and it can overcome small obstacles and hence scattering is low.
- Rate of scattering and the size of the particles are interrelated.
- As the size of the particle increases, the rate of scattering also increases.
- If the size of the particles is greater than the wavelength of light, then the scattering is same for all colours.

Colours of the rising and the setting sun

- Light reaching us from the horizon has to travel long distances through the atmosphere. Colours of shorter wavelength is lost due to scattering. But, the red light undergoes low scattering in the atmosphere. That is why **the horizon appears red during sunset and sunrise.**
- The colour of longer wavelength red in the sun rays reaching the earth from the rising or setting sun. So **the sun in red during sunrise and sunset.**
- Component colours like violet, indigo and blue (shorter wavelength) in sunlight, undergo maximum scattering in the atmosphere. These colours spread in the atmosphere and the combined effect of these colours is seen as the **blue colour of the sky during daytime.**
- There is no atmosphere in the moon. So light reach at the moon is not scattered. There is no presence of any kind of scattered light, **in the moon, sky appears dark.**

TYNDAL EFFECT

- When rays of light pass through a colloidal fluid or suspension, the tiny particles get illuminated due to scattering. Because of this, the path of light is made visible. This phenomenon is **Tyndal effect.**
- The intensity of scattering depends on the size of particles in the colloid.

Infrared Photography

- Infrared radiations are used to take photographs of distant objects. Arrangements which are sensitive to infrared radiations are used in them. Since they are sensitive to visible light also, infrared filters allow infrared radiations alone to pass through them while visible light is completely absorbed.
- Infrared rays travel long distance with less scattering.

7 ELECTRONICS

ELECTRONICS

- Electronics is the branch of science that deals with the study of nature of electrons, their control and use.

Components in an electronic circuit

Resistors

- The function of a resistor is to supply the necessary potential difference to the components by regulating the current in a circuit.
- Resistance is measured in the unit ohm.
- Its symbol is Ω.
- The value of resistance is recorded directly on it or using a colour code.

Inductors

- Inductors are coils of conducting wire which can resist variations of electric current in a circuit.
- The ability to resist the variation of electric current is inductance.
- The unit of inductance is henry.

Capacitors

- Capacitors are components used to store electric charges and release them when necessary.
- A capacitor is constructed by placing a dielectric between two parallel metal plates.
- The unit of capacitance is farad (F).
- Capacitors are commonly known by the dielectric used in them.
- Capacitors which use an electrolyte as a dielectric are electrolytic capacitors.

Semiconductors

- Semiconductors are substances with properties different from both conductors and insulators.
- The two main semiconductors are Germanium and Silicon.

- The conductivity of semiconductors can be increased by suitably adding certain other elements. This process is **doping.**
- Two types of semiconductors,
  p – type semiconductors, n – type semiconductors.

DIODE

- Diode is an electronic component obtained by suitable doping of a semiconductor in such a way that one region is p – type and the other region is n – type.
- One end of a diode is marked positive and the other end, negative.
- When p - end of a diode is connected to positive pole and n - end to the negative pole of a cell, then a current is passed through the diode.
- When a diode is connected in a circuit so that current flows through it, the diode is said to be **forward biased** and when no current flows, the diode is said to be **reverse biased**

Light emitting diode (LED)

- Light emitting from certain diodes when electric current passes through them. They are called LED.

Uses of LED

- Head lamps of vehicles, Tail lamps, Light show, Traffic signals, Display boards etc.

RECTIFICATION

- Diode converts AC into DC. This is rectification. A device which makes this possible is a rectifier.
- During the positive half cycle of the input voltage there is output voltage but during the negative half cycle of the input voltage there is no output voltage. This type rectifier is called **half wave rectifier.**

Full wave rectifier

- A full wave rectifier is one which is arranged to allow the AC to flow continuously in one direction through it.

TRANSISTOR

- A transistor is an electronic component made of semiconductors. They have three terminals.

Amplification

- Amplification is the process of increasing the strength of electrical signals.
- There is no difference in the number of cycles formed in a fixed time interval before and after the amplification. The amplitude of the wave increases.

INTEGRATED CIRCUITS

- The device Integrated circuit or IC is a small semiconductor chip with lakhs of electronic components like resistor, capacitor, diode and transistor suitably linked in them.
- The processor which can be called the brain of the computer is an integrated circuit.

The importance of IC chips:

- Ability to minimise the size of electronic devices since the function of crores of transistors and other components are incorporated in a chip.
- Ability to ensure high efficiency; Credibility; Low energy consumption.
- High longevity; Ability to resist temperature variations up to a certain extent.

❖ **Microprocessor** is an arrangement in which lakhs of transistors are incorporated inside a tiny chip.

TELECOMMUNICATIONS

Telecommunication networks

❖ Internet, Television, Mobile phone etc.

Photonics

❖ Photonics is the branch of science that deals with the study of nature of photons, their control and use.

❖ Photons are the particles of light.

❖ Laser optics (Use - Barcode reader, CD, DVD writer), fibre optics etc., are some of the branches of science

WiFi

❖ This is a method in which data is transferred using radio waves to link equipments, without connecting with wires.

Digital Camera

❖ Digital cameras can convert pictures and scenes into digital signals. This is done by the image sensors in the camera. Films are not used in such cameras

Devices that make use of small digital cameras:

❖ Drones, Mobile phones, CC TV

HD

❖ The full form of HD is high definition.

❖ This is decided depending on the maximum number of pixels in each frame.

Nano Technology

❖ Nanotechnology is the branch of science that makes new substances and parts of devices using particles of size from 1 nm to 100 nm.

❖ The effective application of nanotechnology.

- Bandages which can heal wounds faster
- Highly efficient batteries.
- Paint, varnish etc.
- Display screens which are lighter.
- Dresses and socks which are durable and give cooling in summer time.
- Long lasting tennis ball.

Robotics

❖ Robots are machines that perform their tasks by themselves or by remote control. Robotics is the branch of science which deals with the construction and uses of robots.

8 ENERGY MANAGEMENT

FUELS

- Fuels are substances to produces heat energy.

Combustion/Burning

- Burning is the process in which heat and light are formed by the intense reaction of substances with oxygen.

Substances formed when fuels burn

- Carbon dioxide.Charcoal.Water vapour.Carbon monoxide (CO)

Conditions for the complete combustion

- Dryness, Adequate supply of oxygen.
- Facilities for the removal of gases produced as a result of combustion.

Partial burning

- In the absence of sufficient quantity of oxygen, carbon monoxide is formed in a greater measure, carbon dioxide and smoke in a small measure. This kind of burning is partial burning.

Drawbacks of partial combustion

- Fuel loss, Wastage of time, large scale environmental pollution, large quantity of smoke is produced, Increase the amount of C and CO.

Fossil fuels

- Fossil fuels ate formed by the transformation of animals and plants buried in the earth millions of years ago, in the absence of air, at high temperature and pressure.
- Coal, petroleum and natural gas are fossil fuels.
- They are non-renewable sources of energy.

SOURCE OF FUELS

- Diesel, LPG → Petroleum
- Petrol, Naphtha → Petroleum
- CNG → Natural gas
- Coal → Coal
- Hydrogen → Water
- Electricity → Power stations, water, fossil fuels
- Kerosene → Petroleum
- Fire wood →Trees

More details of CNG, LNG and LPG as fuels

CNG	LNG	LPG
It cannot be liquefied at normal pressure	It can be liquefied at normal pressure	It can be liquefied at normal pressure
Difficult to transport	Easy to transport	Easy to transport
Methane is the main component	Methane is the main component	Main components are propane and Butane

- The advantages of using CNG and LNG as fuels instead of petrol and diesel: Low atmospheric pollution, High energy efficiency, Less expensive

Coal

- Coal is the most abundant fossil fuel in the earth.
- The main component of coal is carbon.

- Based on the carbon content, it is classified into four groups as peat, lignite, anthracite and bituminous coal. When coal is distilled in the absence of air, the substanccs obtaincd arc ammonia, coal gas, coal tar and cokc.

Situations where Coal are used

- It is used as household fuel. It is used as industrial fuel. It is used as the fuel in thcrmal powcr stations.

FUEL EFFICIENCY

- The heat released from different types of fuel is not same at the time of burning. A large difference between the efficiency of firewood and LPG.
- The weight of the LPG filled in the cylinders supplied to our homes is 14.2Kg.

Calorific value

- The amount of heat liberates by the complete combustion of 1 kg of fuel is its calorific value. Its unit is joule/kilogram.

Hydrogen

- Hydrogen is the fuel which has the highest calorific value.
- Hydrogen is used as a fuel in rockets
- This is a highly inflammable and explosive substance. So it is difficult to store and transport it.
- We make use of hydrogen fuel cell to produce electricity by combining hydrogen and oxygen. Such cells are similar to ordinary cell.

Biomass

- The body parts of plants and animals.

Biogas

- When domestic waste is deposited into a biogas plant, biogas is formed by the action of bacteria in the absence of oxygen. Its main constituent is methane.
- The slurry discharged from the plant is good manure.

Thc problcms that arisc duc to combustion

- Smoke is produced; Carbon monoxide is formed; Gases like sulphur dioxide are formed

SOLAR DEVICES

- Solar Panel; Solar water heater; Solar cooker; Solar thermal power plant.

Solar panel

- A large number of solar cells are suitably assembled to form a solar panel. The electric current obtained from a large number of such cells can be stored in a battery and used as and when it is needed.
- In a solar panel light energy is converted in to electrical energy.
- **Uses:** In lighting street lamps, the energy requirement of artificial satellites. Nowadays solar photo voltaic (SPV) power plants capable of producing electricity of thousands of kilowatt are in use.

Black Surfaces

- Black mid rough surfaces absorb radiant heat well. They also emit radiations well.

Solar water heater

- The storage tank is filled with fresh water which is cold. The cold water enters the box which is absorbed by the black painted tube. This heats water inside the tube. Due to low density the hot water moves upwards through the tube and stays upper part of the tank. Fresh cold water being heavy fills the lower part of the tank and continues entering the copper pipe. The water circulation is self maintained. Since hot water has low density it stays the upper part of the tank and taken out from the top.

Solar thermal power plant

- Solar thermal power plant generate electricity using solar energy. Concave reflectors are used to focus the sun's rays on blackened pipes filled with water. As a result, water boils and vaporises. The steam rotates the steam turbine, so that the generator attached to the turbine is activated.
- A power plant of this type operates at Gurgaon in Haryana. The capacity of this plant is 500 kilowatt.

Windmill

- The wind blowing there should have a speed of at least 15 km/h to generate electricity. In Kerala wind mills are established at Kunchikode in Palakkadu district.

NUCLEAR FISSION, NUCLEAR FUSION

- **Nuclear fission** is the process in which the nuclei of greater atomic mass are split into lighter nuclei using neutrons.
- **Nuclear fusion** is the process in which lighter nuclei are combined to form heavier ones.
- Nuclear fission is the process that takes place in an atom bomb.
- **Nuclear fusion** is the process that takes place in a hydrogen bomb.

Conventional energy sources

- Fossil fuels; Biomass; Hydroelectric power; Firewood

Non-conventional energy sources

- Solar energy; Tidal energy; Nuclear energy; Geothermal energy; Biogas ; Wind

Green Energy

- Green energy is the energy produced from natural sources which does not cause environmental pollution.

Things to reduce energy crisis

- Judicious utilisation of energy, The maximum utilisation of solar energy.
- Fossil fuel must be used judiciously, Find out new energy sources.

Prepared By
Fassal Peringolam
Brains Moozhikkal
9048 332 443 8281 332 443