1. Wave motion

Waves can be classified into two types ① Mechanical waves ② Electromagnetic waves

- **Mechanical waves** :- medium is required for the transmission
  Eg:- waves formed on the surface of water
- **Electromagnetic waves** :- medium is not essential for its transmission
  Eg:- Radio waves

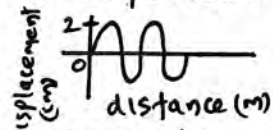
Two types of mechanical waves are ① Transverse waves ② Longitudinal waves

* **Transverse waves** :- particles vibrate perpendicular direction to the wave Eg:- waves formed on the surface of water, Light wave
* **Longitudinal waves** :- particles vibrate in parellel (same) direction to the wave Eg:- sound waves, seismic waves, waves along a spring

Characteristics of waves

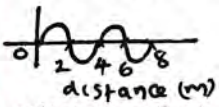
$\lambda = \frac{V}{f}$

- **Amplitude (A)**
  It is the maximum displacement of a particle from its mean position



Amplitude = 2 cm

- **Wavelength (λ)**
  It is the distance between two consecutive crests or troughs.
  → The unit of wavelength is metre (m)



wave length λ = 4 m

- **Frequency (f)**
  It is the number of vibrations in one second.
  → The unit of frequency is Hertz (Hz)

$f = \frac{n}{t}$ f → frequency, n → No: of vibrations, t → time

$f = \frac{V}{\lambda}$ V → wave velocity, λ → wave length

- **wave velocity (V) or speed**
  It is the distance travelled by the wave in one second.
  → The unit of wave velocity or speed is m/s

wave velocity = $\frac{\text{distance}}{\text{time}}$

$V = f\lambda$ V → wave velocity, f → frequency, λ → wave length.

* Speed of sound increases with increase in humidity (amount of water vapour in the air)
* Humidity is less during winter & high in summer

- **Forced vibration**
  Vibration of an object due to the influence of another vibrating object
  Eg:- ① The jerking of building during thunder & bursting of crackers.
  ② Vibration of a table when an excited tuning fork placed on the table

- **Resonance**
  When the natural frequency of an object become equal to the frequency of influencing body then the object will vibrates with maximum amplitude
  Eg:- when the marching frequency of soldiers become equal to the frequency of hanging bridge then the bridge vibrate with maximum amplitude & it collapse

Reverberation
persistance of sound in an auditorium due to multiple reflection of sound

Echo :- The phenomenon of same sound heard again after hearing the original sound

Persistance of hearing
sound persist for a time interval 1/10 second in our ear

Acoustics of buildings
It is the branch of science that deals with the condition to be fulfilled in the construction of a building for clear audibility

Conditions for hearing Echo
* Sound must reflected
* The distance between sound source & Listner must be greater than 17 metre.

- speed of sound in air → 340 m/s

Seismic waves :- waves originated during Earth quake.
Seismology is the study of seismic waves

- Intensity of Earthquake is measured in Richter scale

Multiple reflection is utilised in
- Horn
- Stethescope
- megaphone
- Curved ceiling
- Loudspeaker

The factors which influence the speed of sound in air
- Humidity
- Temperature
- Density
- Direction of Wind

- How to reduce echo or reverberation in a hall ?
  → Hang curtains, walls are made as rough, Large number of audience, chairs having cushion seats

2. EFFECTS OF ELECTRIC CURRENT

Heating effect

Electrical energy → Heat energy

Eg: Electric stove
Electric heater
Electric Iron
Induction cooker
Electric oven

• **Gauge**:- It is the reciprocal of the diameter of the conductor.
As the gauge increases, the thickness of the conductor decreases

Lighting effect

Electrical energy → Light energy

Eg:- Different kinds of bulbs

Mechanical effect

Electrical energy → Mechanical energy

Eg: Electric fan
Electric motor

Chemical effect

Electrical energy → chemical energy

Eg:- Storage battery

Electric power — The unit of Power is watt (W) or J/s

It is the rate of work done

$P = \frac{W}{t}$ $P = \frac{H}{t}$ $P = I^2R$ $P = \frac{V^2}{R}$ $P = VI$

• **Joules law**: The Heat produced in a current carrying conductor is equal to the product of the square of the current (I), the resistance of the conductor (R) and the time of flow of current

$H = I^2Rt$ $H = \frac{V^2t}{R}$ $H = VIt$ $H = Pxt$

• Amperage = $\frac{\text{Power}}{\text{voltage}}$

• when thickness of the conductor increases Amperage also increase

Metal	use	characteristics
Nichrome	heating coil in electric Iron, electric heater etc.	• High melting point • High resistivity • remain in red hot condition for a long time • alloy of Nickel, Iron, chromium manganese
Tungsten	filament of a bulb 	• High melting point • High resistivity • ability to emit white light • High ductility
alloy of tin and lead	fuse wire	thin wire low melting point High resistivity

Different Kinds of lamps

① Incandescent lamps

• A glass bulb containing tungsten filament

working:- when current flows through the filament it become hot and produce white light

• Inert gas is filled in filament lamp to reduce oxidation & evaporation rate of filament

- To increase the efficiency & lifespan of filament

② Discharge lamps

• A glass tube filled with gas at low pressure

working:- when high voltage is applied The gas gets Ionized. it collide with unIonised atom & light produced.

Gas	colour of light
Nitrogen	Red
Neon	orange Red
Hydrogen	Blue
chlorine	Green
Sodium vapour	Yellow
Mercury vapour	white

③ fluorascent lamps

* a long glass tube containing mercury

working:- when current is passed through heating coil it heated & electons are emitted. electons collide with mercury & forms u.v rays fluorascent substance absorb these u-v rays & converted into white light

• In fluorascent lamps, heating coil is coated with thorium oxide to increase the electron efficiency

④ CFL (Compact fluorascent lamp)

* fluorascent tube containing mercury & an electronic circuit

working:- electronic circuit provides High freaquency AC to the electrodes. As a result electons are emitted. it collide with mercury & forms u-v rays. fluorascent substance absorb u-v rays & emitted white light

⑤ LED lamps

it gives more light by consuming less amount of electrical energy

Advantages

* No loss of energy in the form of heat because there is no filament
* It is not harmful to environment. Because there is no mercury

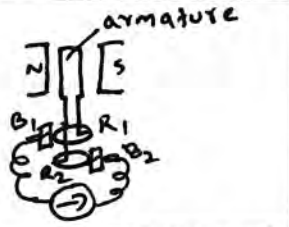
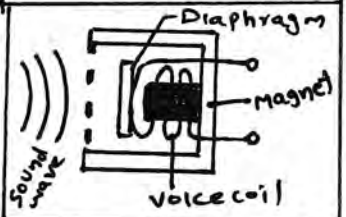
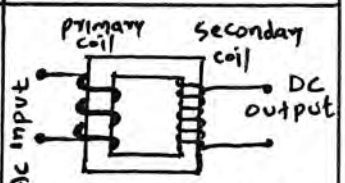
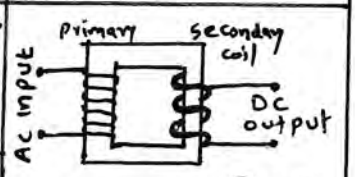
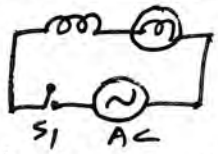
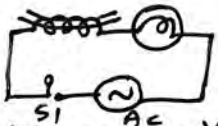
⑥ Arc lamps

* carbon rods kept at a fixed distance in an evacuated glass tube.

working:- when high voltage is applied between carbon rods electric discharge occurs & produce light

Arc lamps are used in search light, film shooting and for rescue work.

3. Electromagnetic Induction

Working Principle	Device	Parts	Energy change or use	Structure
Electromagnetic Induction :- when magnetic flux linked with a coil changes an emf is induced	AC Generator	field magnet slip rings Brushes Armature	• To produce Alternating current Mechanical energy → Electrical energy	
Generator, microphone and Dynamo works on the basis of electromagnetic induction	Moving coil microphone	field magnet voice coil Diaphragm	sound energy → mechanical energy → electrical energy	
Mutual Induction:- when magnetic flux linked with primary coil changes an emf is induced in the secondary coil. Mutual induction only occur in AC	Step up Transformer Transformer only works in AC	Soft Iron core, primary coil, secondary coil	• To increases AC voltage with out power loss Electrical energy ↓ Electrical energy	 • $V_s > V_p$ • $I_s < I_p$ • $\frac{N_s}{N_p} > 1$ $(N_s > N_p)$
Mutual induction does not occur in DC	Step down transformer	Soft Iron core, primary coil, secondary coil	• To decreases AC voltage with out power loss	 • $V_s < V_p$ • $I_s > I_p$ • $\frac{N_s}{N_p} < 1$ $(N_s < N_p)$
Self Induction:- when magnetic flux linked with a coil changes an emf is induced in the same coil. Due to the back EMF voltage decreases	Inductor 	Soft Iron core wounded with a coil (solenoid)	Used to resist the variations of electric current	 when S1 is ON Brightness decrease  Brightness again decrease
Inductor is used in tubelight choke, TV radio tuner circuit			when current flows through inductor energy loss does not occur	

Two types of generators

Single phase	Three phase
• A pair of field magnet & an armature coil • we get single phase line • To produce electricity in small scale used in houses & shops	• Three Armature Coil & a pair of field magnet • we get three diffrent phases • To produce electricity in Large scale armature coils are arranged at 120°

Factors affecting Induced EMF

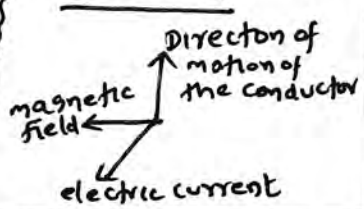
(1) The number of turns of the solenoid
(2) The strength of the magnet
(3) The speed of magnet or coil

Power generator:- Generator used in power station, it is a Three phase AC generator

Main parts of power generator

① **Armature** :- used as Stator
② **field magnet**:- used as rotor for avoiding electric sparking

Flemings Right hand rule



Excitor is an auxiliary DC generator used to provide DC to the Electromagnet in power generator

Frequency of AC is 50 HZ (50 cycles per second) (100 times direction changes in a second)

4. Power Transmission & Distribution

Different Kinds of Power stations

Hydro electric power station	Thermal Power station	Nuclear power station
Potential energy → Kinetic energy → mechanical energy → electrical energy Eg:- moolamattam, pallivasal, Kuttiadi, Sabarigiri	chemical energy → Heat energy → mechanical energy → electrical energy Eg:- Kayamkulam Brahmapuram, Neyveli, Ramagundam	Nuclear energy → Heat energy → mechanical energy → electrical energy Eg:- Tharapur, Kalpakkom, Nerora, Koodamkulam, Kotta

- Electricity is generated at the volt of 11 KV (11,000 V) from power station
- 230 V electricity is supplied to the house hold (domestic) users

Power transmission :- Process of sending electricity to distant places through wires from the power station.

? what are the problems when electric power is transmitted to distant places. Ans) Power loss (energy loss), voltage drop

power grid :- A network connecting diffrent power generating centres and distribution centres. Southern power grid consist of Kerala, Karnataka, tamilnadu

Star connection :- An arrangement of connecting three phase lines from the output of distribution transformer to a common point

voltage at the Neutral point => 0
phase-phase 400 V
phase -Neutral 230 V
phase - Earth 230 V
Earth - Neutral 0 V

Neutral line is Earthed to maintain zero voltage between Neutral & Earth

? what is the role of transformer in power transmission

Ans) In the power station itself a step up transformer is used to increase the volt thus by decreases the current with out any power loss

⇒ fuses & switches should connect in Phase line

House hold wiring

Kwh metre → Main fuse → MCB distribution board

→ All devices should get Phase & Neutral line
→ Devices are connected parellel to each other
→ main switch & kwh meter should connected to the earth
→ Earth socket (big socket) should get connection from Earth line

Stages of power transmission

Power generator → power transformer → 220 KV sub station → large industries
→ 110 KV substation → small industries
→ Distribution transformer → 230 V → Domestic users (House hold consumer)

Series :-

① Device cannot be controlled individually using switches
② current through each device is same But voltage is different

Parellel

① Each device can be controlled using seprate switches
② current through each device is different & voltage is same

Commercial unit of electricity

$$\text{Kwh} = \frac{\text{power(W)} \times \text{time(hour)}}{1000}$$

1 Kwh = 3600000 J

In Delta connection, there is no neutral point

5. Heat

change of state	Potential energy	Intermolecular force of attraction
Solid $\xrightarrow[\text{receive}]{\text{Heat}}$ Liquid	Increases	Decreases
Liquid $\xrightarrow[\text{receive}]{\text{Heat}}$ Gas	Increases	Decreases
Gas $\xrightarrow[\text{releases}]{\text{Heat}}$ Liquid	decreases	Increases
Liquid $\xrightarrow[\text{releases}]{\text{Heat}}$ solid	decreases	Increases

$^{o}C = (F-32) \times \frac{5}{9}$

$^{o}F = \frac{9C}{5} + 32$

$K = {}^{o}C + 273$

$^{o}C = K - 273$

Heat :- It is the total kinetic energy of molecules. unit is Joule

Temperature :- It is the average kinetic energy of molecules. units are K, °c and °F

1 calorie = 4.2 Joule

Melting point of ice = 0°c or 32°F or 273 K

Boiling point of water = 100°c or 212°F or 373 K

Absolute zero = 0 K or -273°c

Heat capacity :- The heat energy required to raise the temperature of a substance by 1K. Its unit is J/K

Specific heat capacity :- The heat energy required to raise the temperature of a substance of mass 1 kg by 1K. unit is J/kgK or $J\,kg^{-1}\,K^{-1}$

Specific heat capacity of water = 4186 J/kg K, Iron = 460 J/kg K

Quantity of heat (Q)

$Q = mc\theta$

$Q = m l_f$

$Q = m l_v$

m → mass

c → specific heat capacity

θ → diffrence in temperature

l_f → latent heat of fusion

l_v → latent heat of vapourisation

Latent heat of fusion (l_f) :- It is the quantity of heat absorbed by 1 kg of solid substance to change into liquid.

L_f of ice = 335×10^3 J/kg

Latent heat of vapourisation (l_v) :- It is the quantity of heat absorbed by 1 kg of liquid substance to change into gas or vapour L_f of water = 226×10^4 J/kg

Vapourisation :- it is the process by which a liquid changes into its gaseous state at its boiling point

Evaporation :- it is the process by which a liquid changes into its vapour form by absorbing heat from surroundings

Factors influence the evaporation

* Nature of substance
* wind
* surface area
* atmospheric temperature

Principle of method of mixtures when a hot body is mixed with cold body, Heat lost by the hot body = Heat gained by cold body

Factors influence the boiling point

* Pressure
* Nature of substance
* Adding of substance to another

Global warming :- The process of increasing the atmospheric temperature due to the green house gases such as CO_2, CFC, methane, water vapour

6. Colours of Light

Dispersion
Splitting of white light into its component colours

- It is due to the difference in wavelength of component colours
- The reason for dispersion is the refraction of light

Rainbow :- Rainbow is formed due to dispersion in the water drops

Rainbow becomes visible only when light comes at a certain angle with the line of vision

Rainbow is seen in the morning at west & in the evening at East

During the formation of Rainbow 2 times refraction and 1 total internal reflection

Arc shape of Rainbow

Violet is seen on the inner edge & Red is seen on the outer edge

Scattering :- Irregular & partial reflection of sunlight, while it passes through a medium

- It is due to difference in wave length of component colours

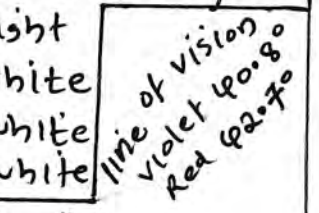
Primary colours of light
Blue, Green and Red. They cannot be obtained by mixing any other colours of light

Secondary colours of light
Yellow, Magenta and cyan. These are obtained by combining any two primary colours.

Yellow = Green + Red
Magenta = Blue + Red
Cyan = Blue + Green

Complementary colour :- it is a colour when combined with a primary colour to get white light

Magenta + Green = White
Yellow + Blue = White
Red + Cyan = White



Same coloured water drops make same angle with the

Persistance of vision
when a person sees an object its image remains in the retina of eye for 1/16 second
Eg ① During heavy rain it appear as glass rods
② Leaf of a fast moving fan seen in circular shape
③ Newtons colour disc appear as white, when it rotate fastly
④ In TV, theatre pictures are seems to be moving

Infrared radiation :- ① it has high wavelength than red ② it can travel long distance with out scattering ③ it can also travel through fog
Uses:- In TV remote, Remote sensing

Blue colour of sky :- Low wavelength colours violet, indigo, Blue scattered more & spreads in the sky

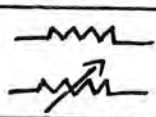
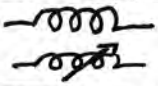
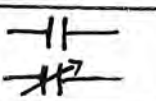
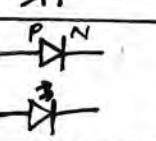
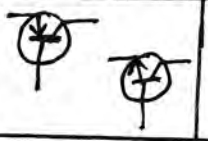
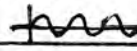
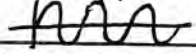
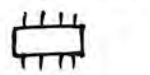
Colour of sun at Sunrise & sun set :- sunlight has to travel a long distance through the atmosphere shorter wavelength scattered away and high wavelength colour such as yellow, orange, Red reaches our eye with less scattering

Opaque object :- It does not allow the passage of light. It reflect its own colour of light & absorb other colour of light. Eg:- Leaf, flower shirt

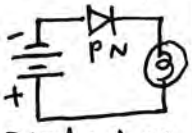
Transparent object - It allow the passage of light of its own colour
Eg:- glass, lens, coloured filter

Tyndall effect :- when light pass through colloid, path of light become visible

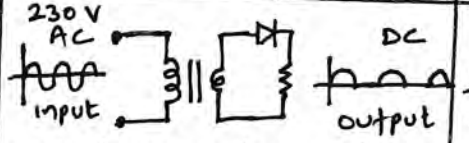
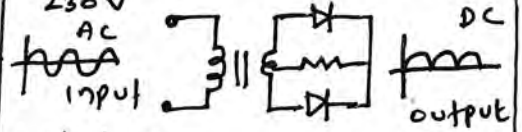
7. Electronics & Modern technology

Component	Symbol	Function	Unit
Resistor Variable resistor		To supply neccessary potential difference by regulating current	Ohm (Ω)
Inductor Variable Inductor		To resist the variations of electric current (to opposes AC)	henry (H), mH
Capacitor Variable capacitor		To store electric charges and release when it is neccessary	farad (f) Mf, Pf
Diode LED (Light Emitting Diode)		Convert AC into DC (Rectification) Emit light	— —
PNP transistor NPN transistor		Process of strengthen the electric signal (amplification) Before amplification  After amplification 	—
IC chip (Integrated circuit)		Ic can perform the functions of resistor, capacitor, Diode and transistor	Inductor cannot Integrated into Ic

Biasing of Diode

Forward biasing	Reverse biasing
P region of the Diode is connected to +ve and N region to -ve of battery	P region of the diode is connected to -ve and N region to +ve of battery
	
Diode conduct during forward bias	Diode does not conduct during reverse bias

Two types of Rectification

Half wave rectification	full wave rectification (centre tapped)
	
• It is done by a single diode • In half wave rectification we get DC output only during +ve half cycle of AC output voltage (DC) • Intermittent • current flows only in one direction • voltage is fluctuating	• It is done by two diodes • In full wave rectification we get DC output in both +ve & -ve half cycle of AC output voltage (DC) • current flow is continous • current flows in one direction • pulsating

- **Doping**:- The process of adding impurities to the semiconductor for increasing conductivity
- **Photonics**:- Branch of science which deals with study of nature, control & use of photons. Laser optics & fibre optics are branches related with photonics
- Laser optics is applied in CD/DVD writer & Bar code reader
- **Nanotechnology**:- Branch of science that makes new substances & parts of devices using particles of size from 1 nm to 100 nm
- **Robotics**:- branch of science deals with construction and use of robots
- **Drones**:- It is a flying Robot can be controlled using G.P.S
- HD (High Definition = 2,73,600 pixels
- **Wifi (wireless fidelity)**:- Data transfered using radio waves without wire
- **Digital camera**:- it converts pictures into digital signal
- **E-waste**:- Electronic wastes include useless and damaged phones, computers, mobile, TV etc.

8. Energy management

- **Fuels** :- it releases energy by burning

Solid fuels	Liquid fuels	Gaseous fuel
fire wood, coal, cow dung	petrol, diesel kerosene	Biogas, coal gas CNG, LNG

- **fossil fuel** :- it is formed by the transformation of animals & plants buried in the earth millions of years ago, in the absence of air at high temperature & pressure
  Three types of fossil fuel are coal, petroleum and Natural gas

- **By products of fossil fuels**

Petroleum	Coal	Natural gas
petrol, diesel, kerosene, Bitumin paraffin wax	coal tar, coal gas coke ammonia	CNG LNG

- Coal is classified into four based on the carbon content peat, Lignite, Anthracite, Bituminous coal

- **Biomas**: Dried biowaste are known as Biomas
  Eg:- fire wood, dried leaf, dried cowdung.
  when Biomas is burnt pollution occur

- **Biogas**: It is formed from the biomas by the action of bacteria in the absence of oxygen.
  Does not cause atmospheric pollution

- Biogas is better fuel than biomas. Biogas has high calorific value than biomas.
  Slury is a good manure which get from biogas.
  main content in the biogas is methane

- **Nuclear fission** :- splitting of heavier Nucleus into lighter Nuclei
- **Nuclear fusion** :- Lighter Nuclei combined to form heavier Nucleus

- Two types of combustion

Complete combustion	Partial combustion
* If the quantity of oxygen is more, complete combustion occur Eg:- burning of flat paper * CO_2 is formed * less amount of soot and smoke * Burns completely & fastly Smokeless oven is an example of complete combustion	* If the quantity of oxygen is less partial combustion occur Eg:- burning of rolled (crumbled) Paper * CO is formed * more amount of soot & smoke * Does not burn completely * Burn slowly

Ethyl mercaptan is added to LPG for identifying Leakage

• CNG	• LNG	• LPG
Compressed Natural Gas • Methane is the main content • Cannot be liquified at normal pressure • Not easy to transport • No pollution • Used as fuel in vehicles	Liquified Natural Gas • Methane is the main content • Easy to liquified at normal pressure • Easy to transport • It is used in factories	Liquified Petroleum Gas • Propane & butane are main component • Easy to liquified at normal pressure • Easy to transport • It is used as house hold fuel

- **Conventional energy** :- It have been used conventionally
  Eg:- fossil fuels, Biomas, fire wood, Hydroelectric power

- **Non conventional energy** It have been used recently
  Eg:- solar energy, tidal energy, Biogas, Nuclear energy

- **Calorific value** The amount of heat released when 1Kg substance is burnt.
  Hydrogen = 150000 KJ/Kg

- **Green energy** :- Energy produced from renewable sources. Eg:- solar cell, tidal, energy, windmill, Hydro electric power.
  Brown energy :- Energy produced from Non renewable sources. Eg:- Thermal power station, Atomic reactors, Diesel engines

- Principle behind Hydrogen bomb is Nuclear fusion