

1. wave motion

① Mechanical waves

waves can be classified into two types 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

① Transverse waves

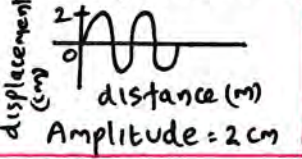
Two types of mechanical waves are ② Longitudinal waves

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

Characteristics of waves

• Amplitude (A)

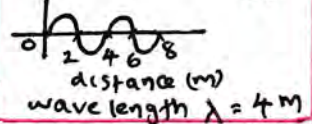
It is the maximum displacement of a particle from its mean position



• wavelength (λ)

It is the distance between two consecutive crests or troughs.

The unit of wavelength is metre (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

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

$$v = f\lambda$$

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 vibrate 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

Persistence of sound in an auditorium due to multiple reflection of sound

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

Persistence 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 & listener 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

Multiple reflection is utilised in

- Horn
- Stethoscope
- megaphone
- Curved ceiling
- Loudspeaker

The factors which influence the speed of sound in air


- Humidity
- Temperature
- Density
- Direction of wind

Intensity of earthquake is measured in Richter scale

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	Lighting effect	Mechanical effect	Chemical effect
Electrical energy → Heat energy Eg: Electric stove Electric heater Electric Iron Induction cooker Electric oven	Electrical energy → Light energy Eg:- Different kinds of bulbs	Electrical energy → Mechanical energy Eg: Electric fan Electric motor	Electrical energy → chemical energy Eg:- Storage battery
<p>Electric power The unit of Power is watt (W) or J/s</p> <p>it is the rate of work done</p> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px;">$P = \frac{W}{t}$</div> <div style="border: 1px solid black; padding: 2px;">$P = \frac{H}{t}$</div> <div style="border: 1px solid black; padding: 2px;">$P = I^2 R$</div> <div style="border: 1px solid black; padding: 2px;">$P = \frac{V^2}{R}$</div> <div style="border: 1px solid black; padding: 2px;">$P = VI$</div> </div>			
<p>• Gauge:- It is the reciprocal of the diameter of the conductor.</p> <p>As the gauge increases, the thickness of the conductor decreases</p>	<p>• 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</p>		<p>• Ampereage = $\frac{\text{Power}}{\text{Voltage}}$</p> <p>• when thickness of the conductor increases Ampereage also increases</p> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px;">$H = I^2 R t$</div> <div style="border: 1px solid black; padding: 2px;">$H = \frac{V^2 t}{R}$</div> </div> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> <div style="border: 1px solid black; padding: 2px;">$H = V I t$</div> <div style="border: 1px solid black; padding: 2px;">$H = P \times t$</div> </div>

Metal	Use	Characteristics	Different kinds of lamps															
Nichrome	heating coil in electric Iron, electric heater etc.	<ul style="list-style-type: none"> High melting point High resistivity Remain in red hot condition for a long time alloy of Nickel, Iron, chromium manganese 	<p>1) Incandescent lamps</p>															
Tungsten	filament of a bulb 	<ul style="list-style-type: none"> High melting point High resistivity ability to emit white light High ductility 	<p>2) Discharge lamps</p>															
alloy of tin and lead	fuse wire	thin wire low melting point High resistivity	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Gas</th> <th style="width: 50%;">colour of light</th> </tr> </thead> <tbody> <tr> <td>Nitrogen</td> <td>Red</td> </tr> <tr> <td>Neon</td> <td>orange Red</td> </tr> <tr> <td>Hydrogen</td> <td>Blue</td> </tr> <tr> <td>chlorine</td> <td>green</td> </tr> <tr> <td>Sodium vapour</td> <td>Yellow</td> </tr> <tr> <td>mercury vapour</td> <td>white</td> </tr> </tbody> </table>		Gas	colour of light	Nitrogen	Red	Neon	orange Red	Hydrogen	Blue	chlorine	green	Sodium vapour	Yellow	mercury vapour	white
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<p>3) Fluorescent lamps</p> <p>* a long glass tube containing mercury</p> <p><u>working</u>:- when current is passed through heating coil it heated & electrons are emitted. electrons collide with mercury & forms u.v rays fluorescent substance absorb these u-v rays & converted into white light</p> <p>• In fluorescent lamps, heating coil is coated with thorium oxide to increase the electron efficiency</p>			<p>4) CFL (Compact fluorescent lamp)</p> <p>* fluorescent tube containing mercury & an electronic circuit</p> <p><u>working</u>:- electronic circuit provides High frequency AC to the electrodes. As a result electrons are emitted. it collide with mercury & forms u-v rays. fluorescent substance absorb u-v rays & emitted white light</p>															
<p>5) LED lamps</p> <p>it gives more light by consuming less amount of electrical energy</p> <p><u>Advantages</u></p> <ul style="list-style-type: none"> * 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 			<p>6) Arc lamps</p> <p>* carbon rods kept at a fixed distance in an evacuated glass tube.</p> <p><u>working</u>:- when high voltage is applied between carbon rods electric discharge occurs & produce light</p> <p>Arc lamps are used in search light, film shooting and for rescue work.</p>															

3. Electro magnetic Induction

Working Principle	Device	Parts	Energy change or use	Structure
<p><u>Electromagnetic Induction</u> :- When magnetic flux linked with a coil changes an emf is induced</p>	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	
<p><u>Mutual Induction</u> :- when magnetic flux linked with primary coil changes an emf is induced in the secondary coil.</p> <p><u>Mutual Induction only occur in AC</u></p>	Step up Transformer	Soft Iron core, Primary coil, Secondary coil	To increases AC voltage with out power loss Electrical energy → Electrical energy	<p> $V_s > V_p$ • $I_s < I_p$ $\frac{N_s}{N_p} > 1$ ($N_s > N_p$) </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	<p> $V_s < V_p$ • $I_s > I_p$ $\frac{N_s}{N_p} < 1$ ($N_s < N_p$) </p>
<p><u>Self Induction</u> :- when magnetic flux linked with a coil changes an emf is induced in the same coil.</p> <p>Due to the back emf voltage decreases</p>	Inductor	Soft Iron core wound with a coil (solenoid)	Used to resist the variations of electric current	<p>When S1 is ON Brightness decrease</p> <p>Brightness again decrease</p>
<p>Two types of generators</p> <p><u>Single phase</u></p> <ul style="list-style-type: none"> A pair of field magnet & an armature coil we get single phase line To produce electricity in small scale used in houses & shops 		<p><u>Three phase</u></p> <ul style="list-style-type: none"> Three Armature coil & a pair of field magnet we get three different phases To produce electricity in large scale armature coils are arranged at 120° 		<p><u>Factors affecting Induced EMF</u></p> <ol style="list-style-type: none"> The number of turns of the solenoid The strength of the magnet The speed of magnet or coil <p><u>Power generator</u> :- Generator used in power station, it is a Three phase AC generator</p> <p><u>Main parts of Power generator</u></p> <ol style="list-style-type: none"> <u>Armature</u> :- used as stator <u>field magnet</u> :- used as rotor for avoiding electric sparking
<p>Excitor is an auxiliary DC generator used to provide DC to the Electromagnet in power generator</p>			<p>frequency of AC is 50 Hz (50 cycles per second) (100 times direction changes in a second)</p>	<p><u>Flemings Right hand rule</u></p> <p>direction of motion of the conductor ↑ magnetic field ← electric current ⊙</p>

4. Power Transmission & Distribution

Different Kinds of Power Stations

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

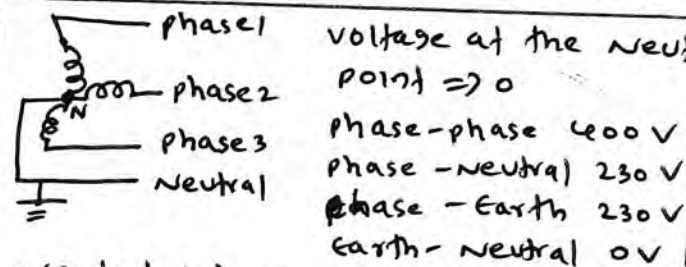
- Electricity is generated at the volt of 11 KV (11,000V) from power station
- 230 V electricity is supplied to the house hold (domestic) users

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

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

Power grid :- A network connecting different 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 $\Rightarrow 0$
 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

Q what is the role of transformer in power transmission

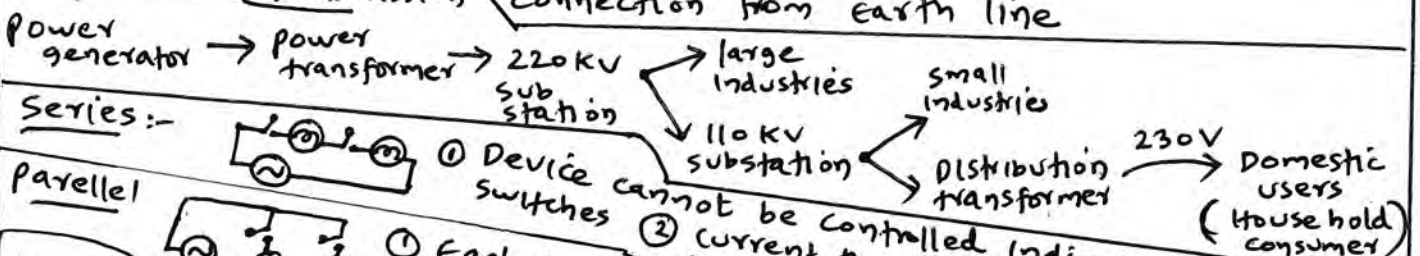
Ans) In the power station itself a step up transformer is used to increase the volt thus by decreases the current with out any power loss

\Rightarrow fuses & switches should connect in phase line

House hold wiring \rightarrow All devices should get phase & neutral line

Kwh metre \rightarrow main fuse \rightarrow Devices are connected parallel to each other
 \rightarrow main switch \rightarrow ELCB \rightarrow main switch & kwh meter should connected to the earth
 \rightarrow MCB distribution board

Stages of power transmission \rightarrow Earth socket (big socket) should get connection from earth line



Series :-

Parallel



- ① Device cannot be controlled individually using seprate switches
 - ② current through each device is same but voltage is different
- ① Each device can be controlled using seprate switches
 - ② current through each device is different & voltage is same

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

$1 Kwh = 3600000 J$

In Delta connection, there is no neutral point

5. Heat

change of state	Potential energy	Intermolecular force of attraction	
Solid $\xrightarrow{\text{Heat receive}}$ Liquid	Increases	Decreases	$^{\circ}C = (F - 32) \times \frac{5}{9}$ $^{\circ}F = \frac{9C}{5} + 32$ $K = ^{\circ}C + 273$ $^{\circ}C = K - 273$
Liquid $\xrightarrow{\text{Heat receive}}$ Gas	Increases	Decreases	
Gas $\xrightarrow{\text{Heat releases}}$ Liquid	decreases	Increases	
Liquid $\xrightarrow{\text{Heat releases}}$ solid	decreases	Increases	

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

temperature :- it is the average kinetic energy of molecules.

units are K, $^{\circ}C$ and $^{\circ}F$

1 calorie = 4.2 Joule

melting point of ice = $0^{\circ}C$ or $32^{\circ}F$ or $273 K$ Absolute zero

Boiling point of water = $100^{\circ}C$ or $212^{\circ}F$ or $373 K$ = $0 K$ or $-273^{\circ}C$

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

Specific heat capacity of water = $4186 J/kg K$, $1 \text{ ton} = 460 J/kg K$ or $J kg^{-1} K^{-1}$

Quantity of heat (Q)
 $Q = m c \theta$ $m \rightarrow$ mass
 $Q = m l_f$ $c \rightarrow$ specific heat capacity
 $Q = m l_v$ $\theta \rightarrow$ difference in temperature

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 = $335 \times 10^3 J/kg$

$l_f \rightarrow$ latent heat of fusion

$l_v \rightarrow$ latent heat of vapourisation

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_v of water = $226 \times 10^4 J/kg$

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 gas such as CO_2 , CFC, methane, water vapour

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

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

Same coloured water drops make same angle with the

Persistence of vision

When a person sees an object its image remains in the retina of eye for $\frac{1}{16}$ 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

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

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

line of vision
violet 40° 80
Red 42° 70

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 & set:- Sun light 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

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		To supply necessary potential difference by regulating current	ohm (Ω)
Variable resistor			
Inductor		To resist the variations of electric current (to opposes AC)	henry (H), mH
Variable Inductor			
Capacitor		To store electric charges and release when it is necessary	farad (F) μF , pF
Variable capacitor			
Diode		Convert AC into DC (Rectification)	—
LED (Light Emitting Diode)		Emit light	—
PNP transistor		Process of strengthen the electric signal (Amplification)	—
NPN transistor			
IC chip (Integrated circuit)		IC can perform the functions of resistor, capacitor, diode and transistor	Inductor cannot Integrated into IC
<u>Biasing of Diode</u>		<u>Two types of Rectification</u>	
forward biasing	Reverse biasing	Half wave rectification	full wave rectification (Centre tapped)
<p><u>Region of the Diode</u> is connected to <u>+ve</u> and <u>N</u> region to <u>-ve</u> of battery</p> <p>Diode conduct during forward bias</p>	<p><u>Region of the diode</u> is connected to <u>-ve</u> and <u>N</u> region to <u>+ve</u> of battery</p> <p>Diode does not conduct during reverse bias</p>	<p>230V AC Input</p> <p>DC output</p> <ul style="list-style-type: none"> 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 	<p>230V AC Input</p> <p>DC output</p> <ul style="list-style-type: none"> 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 continuous current flows in one direction pulsating
<p>• <u>Doping</u>:- The process of adding impurities to the semiconductor for increasing conductivity</p>		<p>• <u>Photonics</u>:- Branch of science which deals with study of nature, control & use of photons. Laser optics & fibre optics are branches related with photonics</p>	
<p>• Laser optics is applied in CD/DVD writer & Bar code reader</p>			
<p>• <u>Nanotechnology</u>:- Branch of science that makes new substances & parts of devices using particles of size from 1 nm to 100 nm</p>			
<p>• <u>Robotics</u>:- branch of science deals with construction and use of robots</p>			
<p>• <u>Drones</u>:- It is a flying robot can be controlled using G.P.S</p>			
<p>• <u>HD (High Definition)</u> = 2,73,600 pixels</p>			
<p>• <u>wifi (wireless fidelity)</u>:- Data transferred using radio waves without wire</p>			
<p>• <u>Digital camera</u>:- it converts pictures into digital signal computers, mobile</p>			
<p>• <u>E-waste</u>:- Electronic wastes include useless and damaged phones, TV etc.</p>			

8. Energy management Ethyl mercaptan is added to LPG for identifying leakage

<p>• <u>fuels</u> :- it releases energy by burning</p>		<p>• Two types of combustion</p>	
<p>Solid fuels</p>	<p>Liquid fuels</p>	<p>Gaseous fuel</p>	<p>Complete combustion</p>
<p>fire wood, coal, cow dung</p>	<p>Petrol, diesel, kerosene</p>	<p>Biogas, coal gas, CNG, LNG</p>	<p>Partial combustion</p>

• 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

• Complete combustion
 * If the quantity of oxygen is more, complete combustion occur
 Eg:- burning of flat paper 
 * CO₂ is formed
 * less amount of soot and smoke
 * Burns completely & fastly
 Smokeless oven is an example of complete combustion

• Partial 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

• By products of fossil fuels

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

<p>• CNG</p> <p>Compressed Natural Gas</p> <p>• Methane is the main content</p> <p>• Cannot be liquified at normal pressure</p> <p>• Not easy to transport</p> <p>• No pollution</p> <p>• used as fuel in vehicles</p>	<p>• LNG</p> <p>Liquidified Natural Gas</p> <p>• Methane is the main content</p> <p>• Easy to liquified at normal pressure</p> <p>• Easy to transport</p> <p>• It is used in factories</p>	<p>• LPG</p> <p>Liquidified Petroleum Gas</p> <p>• Propane & butane are main component</p> <p>• Easy to liquified at normal pressure</p> <p>• Easy to transport</p> <p>• It is used as house hold fuel</p>
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• Coal is classified into four based on the carbon content: peat, lignite, Anthracite, Bituminous coal

<p>• <u>Biomass</u></p> <p>Dried biowaste are known as biomass Eg:- fire wood, dried leaf, dried cowdung. when biomass is burnt pollution occur</p>	<p>• <u>Biogas</u></p> <p>It is formed from the biomass by the action of bacteria in the absence of oxygen. Does not cause atmospheric pollution</p>
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<p>• <u>Conventional energy</u> :- It have been used conventionally Eg:- fossil fuels, biomass, fire wood, hydroelectric power</p>	<p>• <u>Nonconventional energy</u> It have been used recently Eg:- solar energy, tidal energy, biomass, nuclear energy</p>	<p>• <u>Calorific value</u> The amount of heat released when 1kg substance is burnt. Hydrogen = 150000 kJ/kg</p>
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• Biogas is better fuel than biomass. Biogas has high calorific value than biomass. Slurry is a good manure which get from biogas. main content in the biogas is methane

• 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

• Nuclear fission :- splitting of heavier nucleus into lighter nuclei
 • Nuclear fusion :- Lighter nuclei combined to form heavier nucleus