

* Unit - 1

- Conventional Power Generation.

- Steam power station
- Nuclear power plant
- Gas turbine power plant
- Hydroelectric power plant
- Schematic arrangement
- Advantages and disadvantages
- Thermolectric and Thermionic generators
- Environmental aspects for selecting the sites and location of power plants.

* Unit - 2

- Renewable power generation:-

- Solar
- Wind
- Bio-gas, Bio-mass
- Ocean Thermal Energy Conversion (OTEC)
- Tidal
- Fuel cell
- Magneto hydro dynamics (MHD)
- Schematic arrangement
- Advantages and disadvantages.

* Unit - 3

- Energy conservation:-

- Scope for energy conservation and its benefits
- Energy conservation principle

- Maximum energy efficiency
- Maximum passed effectiveness
- Methods and techniques of energy
- conservation in ventilation and air conditioners, compressors, pump, fans, and blowers.
- Energy conservation in electric Furrance, ovens and boilers, lighting techniques.

★

Unit - 4

- Air pollution:-
- Environmental and human health,
- Air pollution, sources, effects, control measures, particulate emission, air quality standard, measurement of air pollution.

★

Unit - 5

- Water pollution:-

- Water pollution, effects, control measures, Noise pollution, effects and control measures,
- Disposal of solid waste, biomedical waste, Thermal pollution, soil pollution, Nuclear hazard.

★

Unit - 6

- Environmental laws and sustainable development:-
- Environmental protection act .
- Air act
- Child life protection act .
- Forest conservation act .

- Disaster management.
- Urban problems related to energy.
- Water shaft management.
- Rain water harvesting
- Water conservation.

4-8-17 chpt 1 Conventional Power Generation

* Steam power station :-

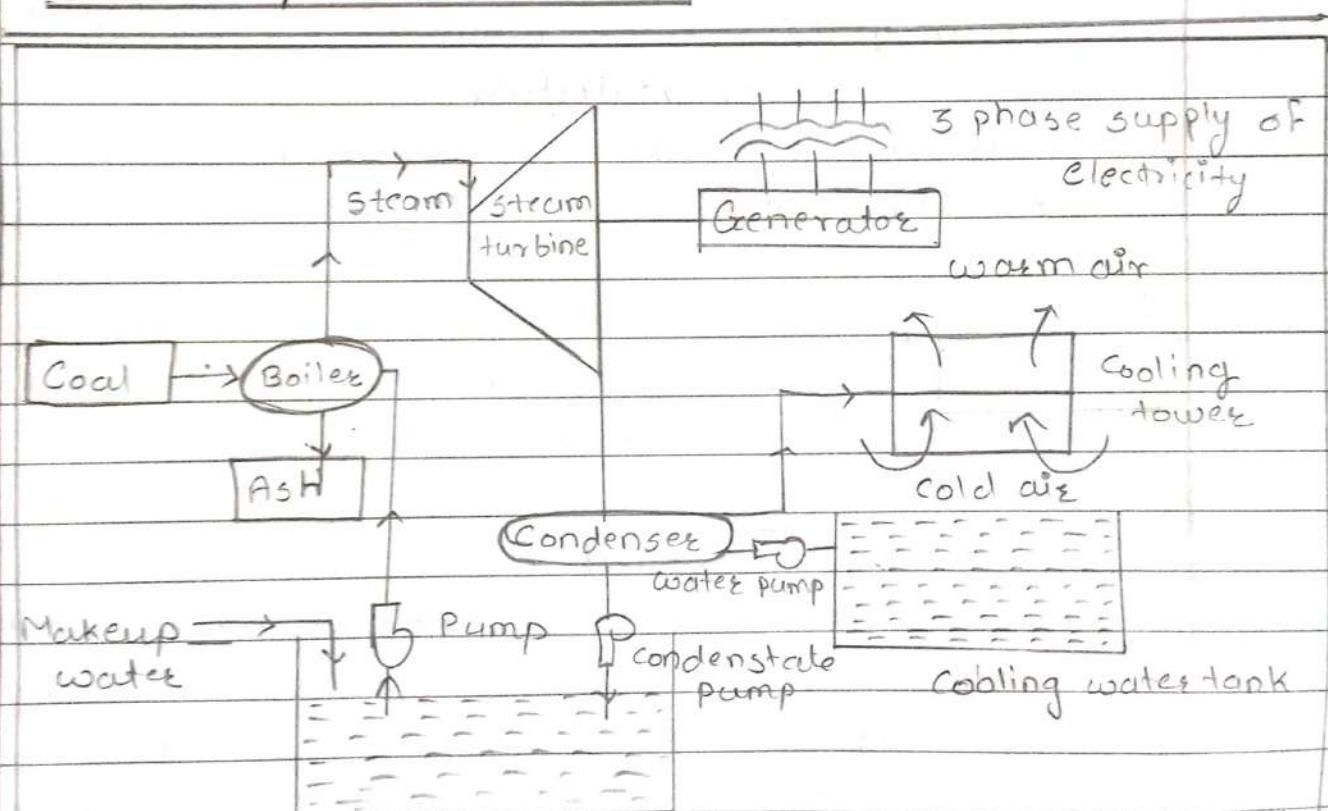


Fig: Steam power station.

Steam power station.

* Elements or components of steam power plant

1) Coal & ash circuit.

- Coal is burned and heat is used for heating water

- After burning coal ash is formed and collected separately.

2) Steam turbine & Boiler:-

- Boilers convert water into steam

- Steam passes over blades of turbine and turbine starts rotating.

- Turbine is connected to generator and produce electricity.

3) Electrical circuit :-

- Shaft of generator is connected to the shaft of turbine, generator produce electricity.

4) Cooling water circuit :-

- It contains condenser, cooling tower and pump

- Steam is converted into hot water

- By using cooling tower and cooling water tank hot water converted into cold water.

- Makeup water is supplied for filling the losses, due to the vapourisation.

* Economiser, air Pre heater, super heater are used in steam power station to improve efficiency.

* Advantages:-

- Electricity is free of radiation.
- Electricity is cheap
- Area required is less.
- Capacity of this plant is high

* Disadvantages or limitations:-

- Because of exhaust gases cause air pollution
- Maintenance cost is high
- Possibility of accident because of damage of steam pipeline.
- Ash handling is problematic.

* Applications:-

- To generate electricity
- It is also used in Sugar Factory to produce electricity.

* Nuclear Power Plant:-

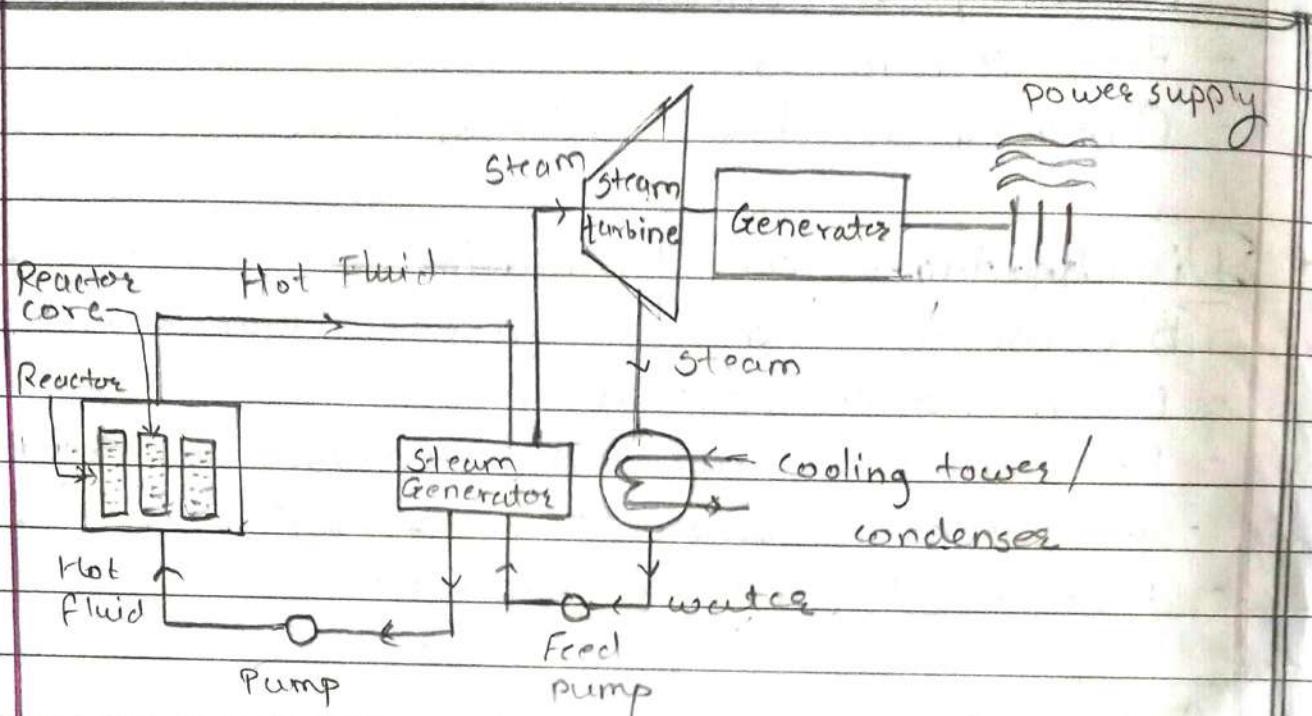


Fig:- Nuclear Power Plant

* Elements / components of Nuclear Power plant.

- 1) Nuclear Reactor
- 2) Steam Generator
- 3) Steam turbine
- 4) Condenser/ Cooling tower
- 5) Generator

* Working:-

- Reactor produces heat.
- Heat enters into steam generator & heat to water and produce steam.

- Steam enters in steam turbine, turbine starts rotating, turbine connected to the generator, generator produce electricity.
- Steam is condensed and water is heat feed back by using pump.
- Heat is also feedback by using pump.

* Advantages:-

- Electricity produced is in large quantity.
- More electricity is produced in short time.

* Disadvantages / Limitations:-

- Radioactive elements emits radiations which are harmful to humans.
- Construction and maintenance is very high.
- More safety precaution is required.
- It is very dangerous for handling.
- Site selection is major problem.

* Hydro power plant :

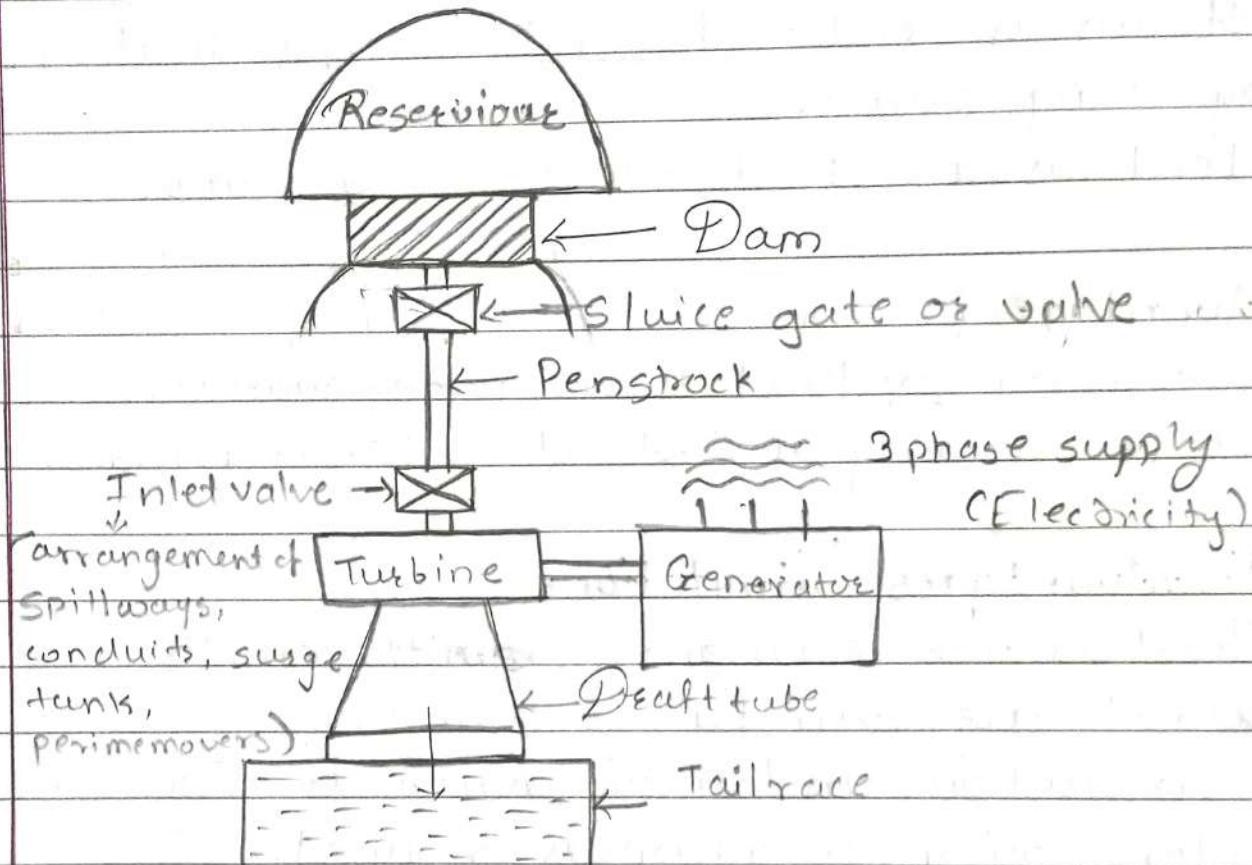
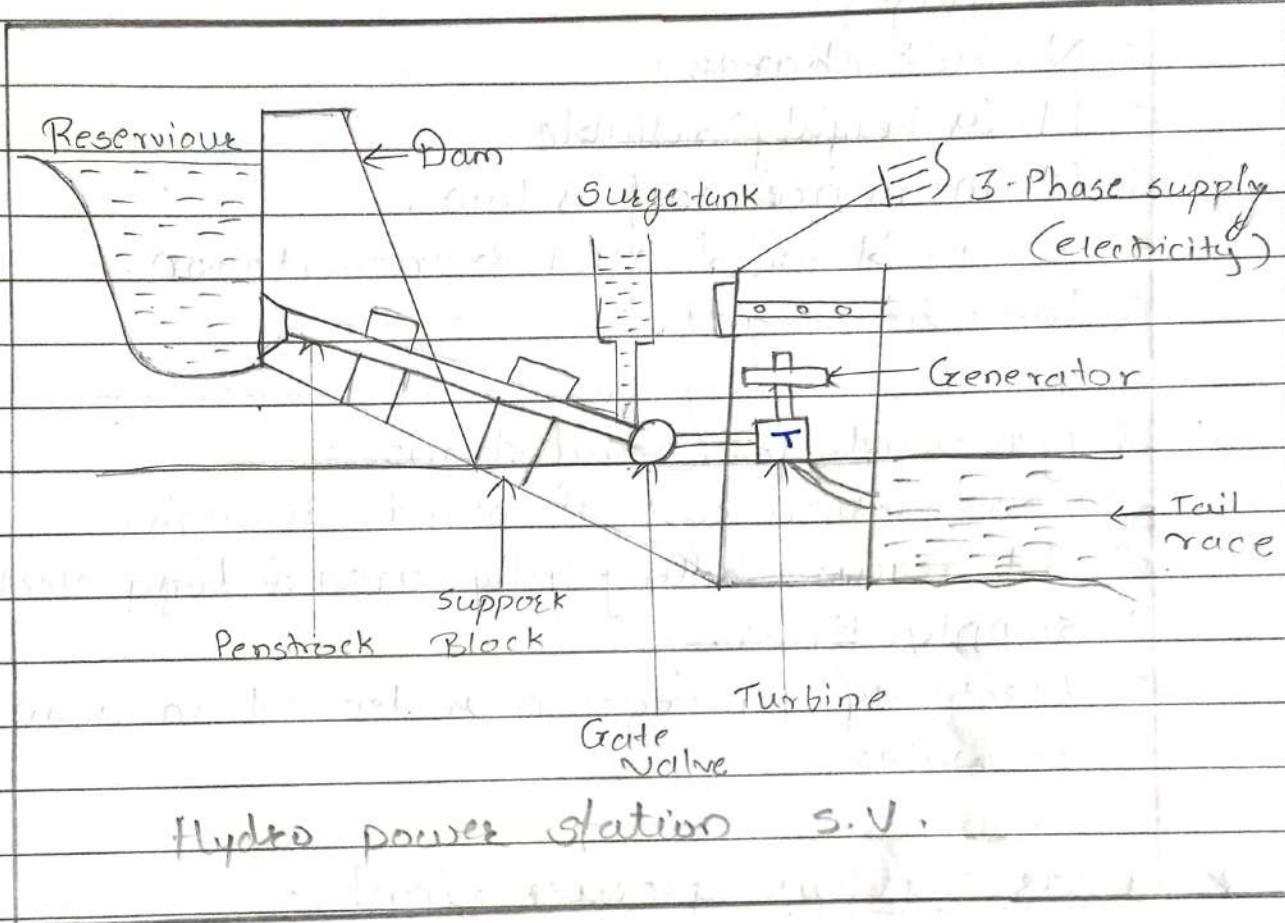


Fig- Hydro Power Station

F.V.

Hydro power plant - S.V.

Draw this diagram in exam.



* Elements / components of hydroelectric power plant

- Catchment area - The area behind the dam
- Reservoir - It is used for storing water.
- Dam - It is used for raising water level.
- Prime movers - It converts hydrostatic energy of (penstock) water into mechanical.
- Surge tank - It is used to control the pressure of water.
- Draft tube - It is used to increase the pressure of back water.
- Tail race - Water is collected in tail race.

- Power house and equipment - It is the arrangement for generate electricity.

* Advantages -

- No fuel charge.
- It is highly reliable.
- Maintenance cost is low.
- No problem of fuel transportation.
- Long life plant.

* Disadvantages / limitations:-

- Construction cost of plant is high.
- It require hitting hilly area & long electricity supply lines.
- Electricity generation is depend on quantity of water.

* Gas turbine power plant:-

- It is one of the thermal power plant.
- It convert heat energy into mechanical energy.

① Open cycle gas turbine power plant.

- Working - In this power plant consist of compressor, combustion chamber, gas turbine, Generator.
- Initially starting motor is started by electricity.
- Motor is coupled to the compressor.

- Compressor takes atmosphere air & compress it.
- Pressure and temp. of air increased.

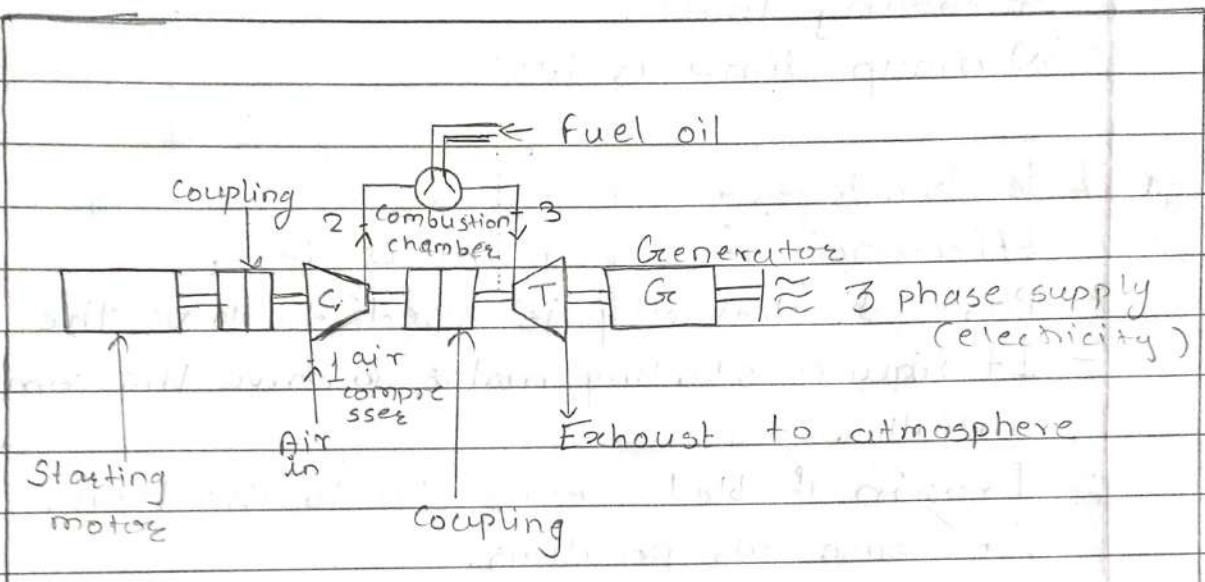


Fig- Open cycle gas turbine power plant.

- That air supply towards combustion chamber.
- In combustion chamber mixture of air & fuel is burned.
- High pressure heat is produced in combustion chamber.
- That heat passes towards turbine, turbine starts rotating, turbines are connected to the generator.
- Generator produce the electricity.
- Heat & gases coming out from the turbine are exhausted to atmosphere. Therefore it is known as open cycle gas turbine power plant.

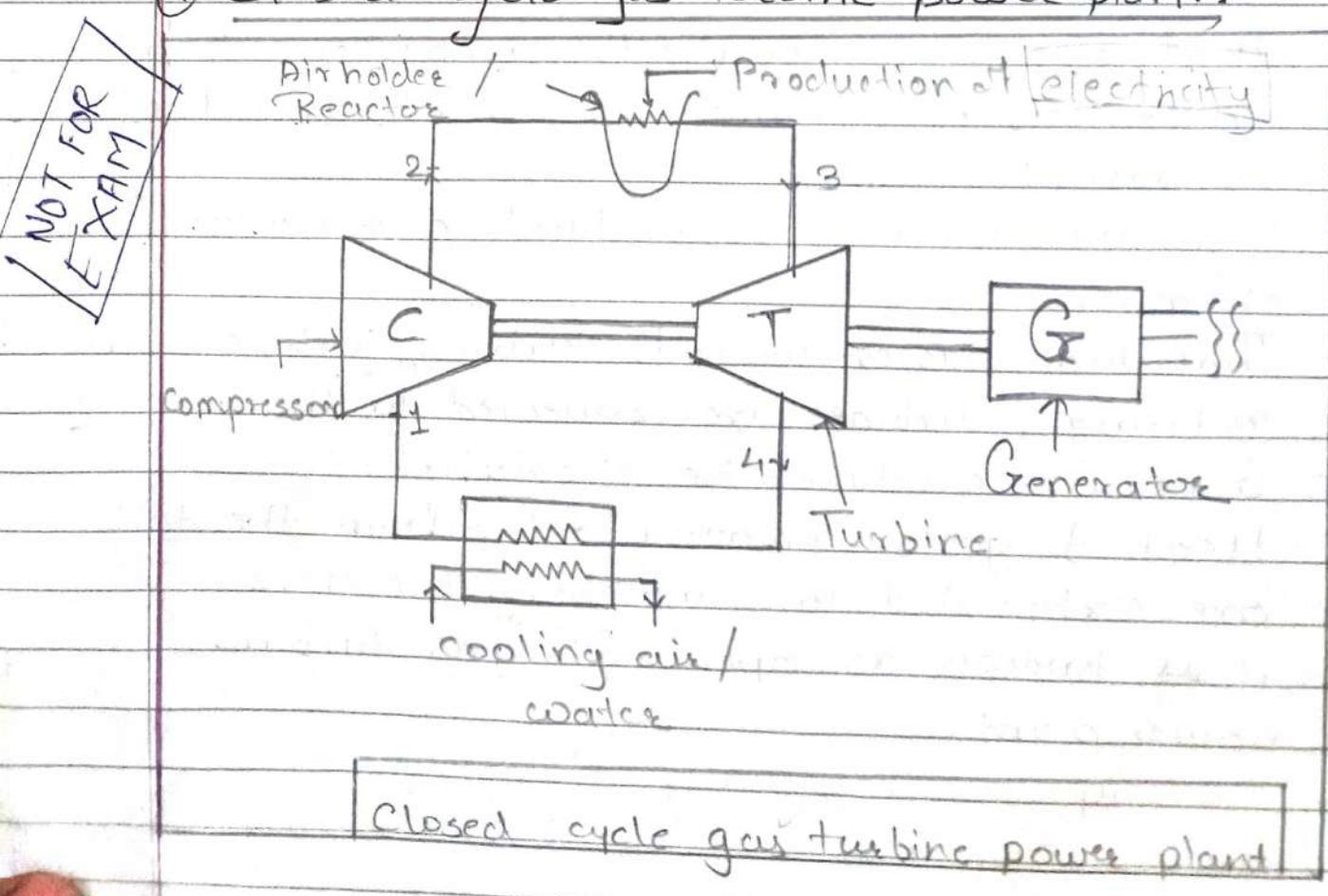
* Advantages -

- It require less space.
- There is no need of cooling water, condenser, & cooling tower.
- Warmup time is less.

* Disadvantages -

- Efficiency of this plant is less.
- Part of electricity is used to drive the compressor.
- It requires starting motor to drive the compressor initially.
- Erosion of blades occurs due to the heat.
- It cause air pollution.

② Closed cycle gas turbine power plant.



- Working -

- 1) In closed cycle gas turbine power plant, air is compressed in compressor.
- 2) High pressure air is passes through air heater.
- 3) High pressure & high temp. air is supply to turbine.
- 4) Turbines are connected to the generator, electricity is generated inside generator.
- 5) The exhaust hot air from turbine is cooled to its original temp, in the heat exchanger.
- 6) This air is recirculated through the cycle.
Hence it is called as closed cycle.

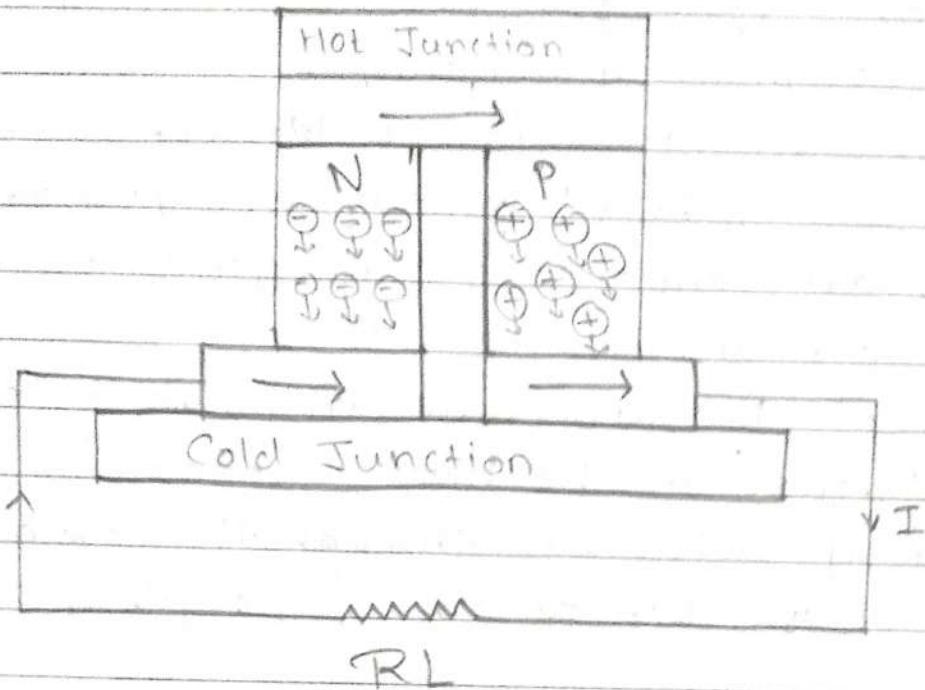
- Advantages -

- Higher thermal efficiency.
- Air is recirculated.
- Less erosion of turbine blades.
- Need of air filtration in open cycle is now eliminated.

- Disadvantages -

- Full heat of the fuel is not utilized.
- Cooling medium is required.
- Space required is more.

* Thermoelectric Generators [TEG]



Thermoelectric generators

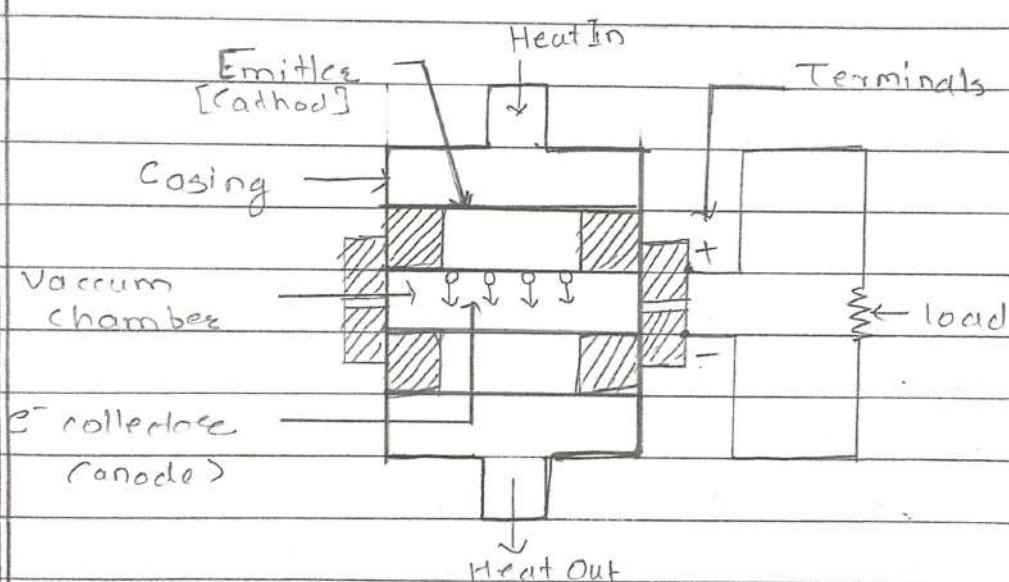
- Thermoelectric power generators are the devices which used to convert temp. diff. between two junctions into electrical energy.
- Working of thermoelectric generators is based on Seebeck effect.
- TEG is a device that converts heat directly into electricity called seebeck effect.
- Reverse effect i.e. transform electrical energy into thermal energy is called peltier effect.
-

Working -

- TEG having heat source at one end and cold junction at other end.
- Hot junction is kept at higher temp.

- Temp. difference between two junctions is ΔT
- The applied heat to the hot junction move the e^- in N-type semiconductors & holds in the P-type semiconductors. -.
- * To flow away from the hot junction
- Thereby producing a electrical P.D.
- Current is flow through the load resistance.
- The efficiency of this generator is 2 to 5 %.

* Thermionic generator / Thermionic power generator (TPG)



Thermionic Generator

- In thermionic emission is the emission of e^- from metal surface due to the heat.
- Thermionic generators converts heat energy into electrical energy.
- In thermionic generator there are 2 diodes cathode and anode.

- cathod emits and anode is collector.
- e^- are emitted from cathod due to heat & this e^- are collected by anode.
- Anode oppose these e^- for collecting.
- This oppose force for e^- cause the electric potential diff.
- Load resistance is connected to the circuit and current is flow across circuit.

* Environmental aspects for selecting the sites and location for power plant. (4 Mks)

→ The principle factors to be consider for site selection at power plants.

- ① Availability of raw material & transport facility-
 - Power plants require large amount of raw material
 - transport facility like good quality road, availability of vehicles.
- ② Availability of water & fuel-
 - large amount of water is needed for power plant
 - Fuels also required
- ③ Skilled man power availability-
 - Power plant required labour for construction & operation.
- ④ Land acquisition cost -
 - each site will have unique land acquisition requirement & cost.

⑤ Degradation of local air quality:-

- Operating power plant produce pollutants & exhaust gases. This pollutant regulated by central pollution control board [C PCB]

⑥ Land use impact -

- For power plant forest are a valuable factors.
- Site evaluation use the forest resources & nearby land.
- Effect of plant construction & operation on these resources is important

⑦ Transmission grid accessibility.

- An electrical grid is an interconnected network for delivering electricity from suppliers to consumers. It consists of substation, high voltage transmission lines.

⑧ Electricity consumption point.

- A power plant must be located near the road to which it is supplying the power.

* Environmental aspects -

- Local regulation and law will control the effect of power station on the local environment. The important factors are exhaust emission like - (Carbon monoxide) CO, SO₂, NO_x.

- Height of Chimney
- Noise level at the site boundary.
- Treatment of boiler blow-water and waste products.

* Site selection for steam power plant-

- Following factors are to be considered for selection of site
- 1] Availability of raw material and fuel.
 - 2] Availability of labour or man power.
 - 3] Availability of water.
 - 4] Land availability and its cost.
 - 5] Transport Facilities.
 - 6] Pollution control.
 - 7] Environmental and social problems.

* Site selection criteria for nuclear power plant-

- Following factors are to be consider for selection of site.

- 1] Land availability.
- 2] Access to electrical grid
- 3] Transportation facility
- 4] Skilled man power.
- 5] Water availability
- 6] Disposal of nuclear waste
- 7] Soil type

* Site selection criteria for hydroelectric power plant

- Following factors are consider for selection of site.

- 1] Availability of water head & water storage facility
- 2] Slope of the hill.
- 3] Land availability & its cost.
- 4] Transport Facility.

- 5) Availability of construction material.
- 6] Control of pollution
- 7] Environmental & social problems
- 8] Distance betn nearest substation.
- 9] Soil type.

* Site selection criteria for gas turbine power plant -

- Following factors are to be considered for selection of sites.

- 1] Land availability and its cost.
- 2] Availability of man power.
- 3] Availability of water.
- 4] Transportation facility.
- 5] Distance from substation.
- 6] Environmental & social problems.

Chp.2 - Renewable Power Generation.

Content -

- 1) Solar
- 2) Wind
- 3) Biogas - Biomass
- 4) Ocean thermal energy conversion (OTEC)
- 5) Tidal
- 6) Fuel cell
- 7) Magneto hydro dynamics
- 8) Schematic arrangement
- 9) Advantages & disadvantages.

* Renewable Energy sources.

- Solar energy , wind energy , biogass & biomass , ocean energy , tidal energy are considered as renewable energy sources.

Advantages -

- They are clean & environment friendly energy sources.
- They are non-depleting energy sources.
- Less maintenance cost.
- They are freely available.
- It increase energy security.
- They do not emit exhaust gasses.
- They are pollution free.

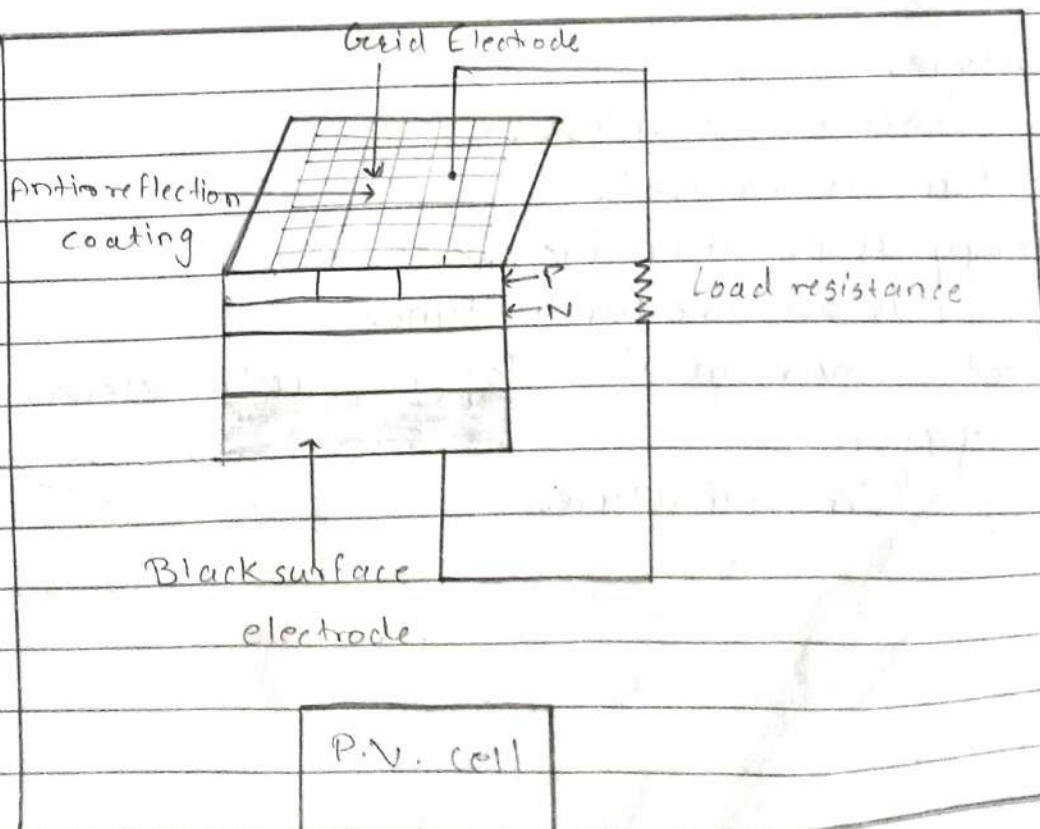
Disadvantages -

- Renewable energy sources are unreliable.
- They have lower efficiency.
- Capacity to generate electricity is less.
- For high capacity large space is required.

* Solar -

- Sun is the source of all form of energy available on the earth.
- They receives this radiant energy from the sun in the form of electromagnetic waves.
- Solar energy is used through photosynthesis by plants.

~~- PV cell / Solar cell (Photovoltaic cell)~~ Q.2. (2) page



- PV cell is work on the principle of photovoltaic effect.
- Photovoltaic effect is, if photon of solar rays has energy greater than band gap then the e^- is emitted and these flow of e^- creates a current.
- Solar cell is a semiconductor device which converts the radiation energy or solar energy into electrical energy by photovoltaic effect.
- They are made from semiconductors, polycrystalline silicon.
- PU cell use one or more solar modules to convert solar energy into electrical energy.
- PV cell is crystalline silicon.
- PV module is large number of cells are connected in series and parallel.
- Pv array is modules connected in series & parallel for more output.

Advantages -

- maintenance cost is less.
- No fuel is required.
- Energy is pollution free.
- Energy is available for life time.
- Direct conversion of solar rays into electrical energy.
- Easy to manufacture.

Disadvantages -

- Efficiency is less
- Capacity is less, for high capacity large number of solar modules are required.
- Space required is large
- Solar energy is unreliable.

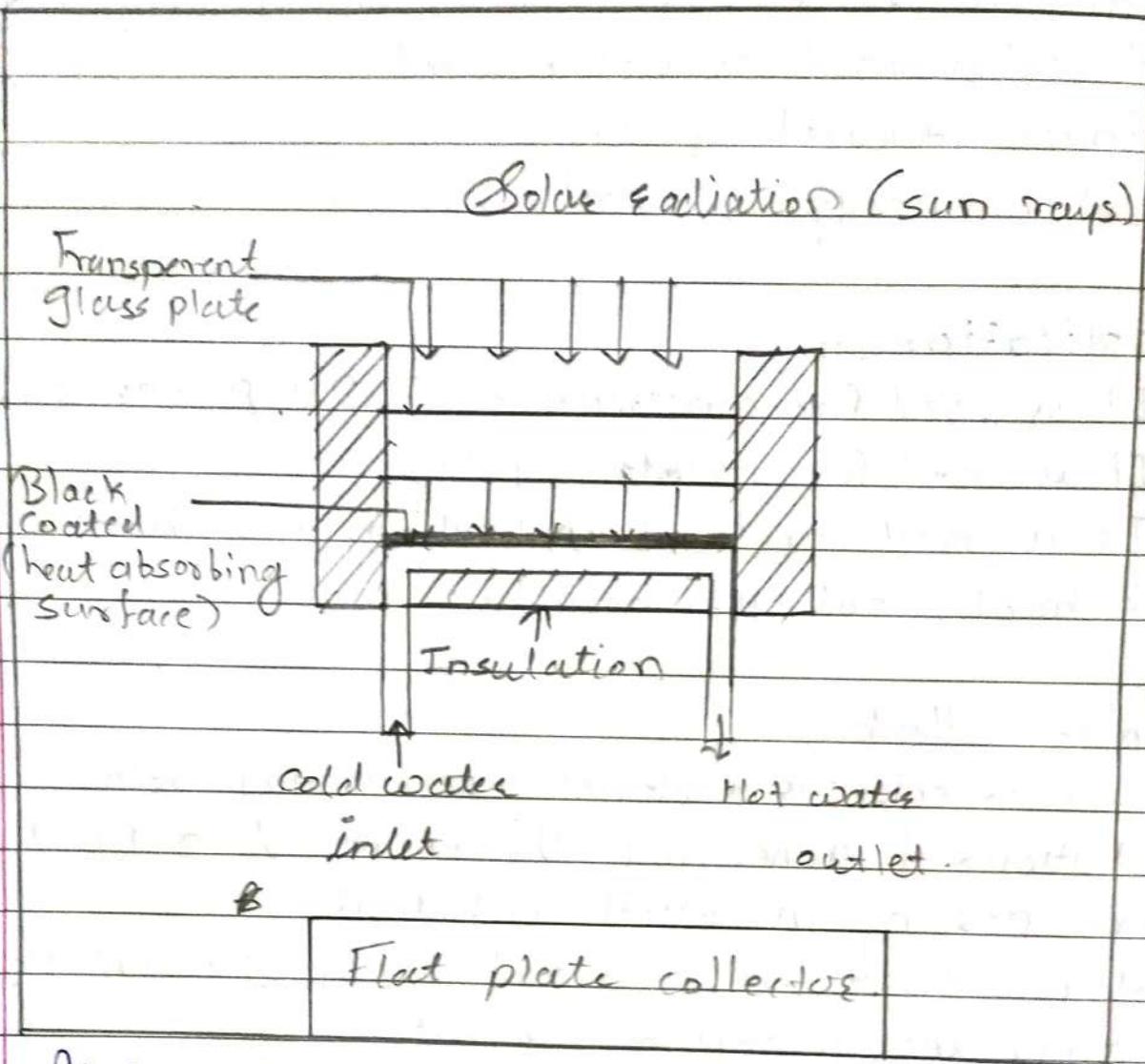
Applications -

- It is used for construction of PV power system.
- It is used for street lighting.
- It is used for local applications like home, school, colleges, hospitals.

* Solar collector -

- Solar collector is a device for collecting solar radiations & transferring the energy to a fluid or air passing in contact with heat.
- Solar collectors use solar radiations & convert that energy into heat or electricity.

* flat plate collector / Non-concentrating solar collector



- Flat plate collector consist of transparent glass plate black coated surface, which is observer plate, inlet & outlet for water, insulation.
- Solar rays incident on glass plate.
- This solar energy is trapped by black coated surface, which is observer plate.
- Absorber plate is made up of metal like copper, steel, aluminium.
- Water tubes are fitted in the observer plate.
- Water tubes are made from the material like copper.
- cold water enters into a tubes of water gets heated by

the heat from tubes.

- The hot water is collected in storage tank.
- Storage tank is made from insulating materials.
- There is circulation of water from inlet to outlet.

Advantages -

- No fuel is required.
- Maintenance & construction cost is less.
- It is pollution free.
- Efficiency is high for local application.

Disadvantages -

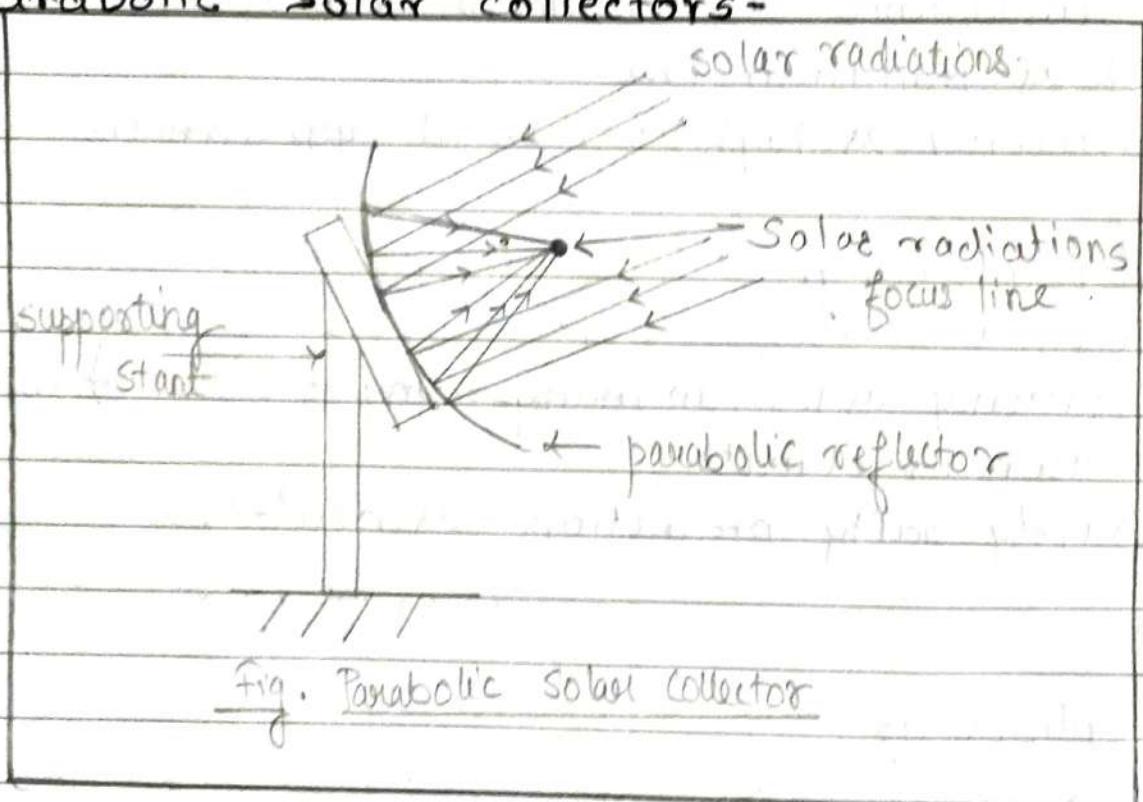
- It is unreliable.
- Efficiency is less in many rainy season & winter season or climate.
- Safety safety precaution is needed.

* Applications -

- It is used for heating water in home, hospitals, schools, colleges, hostels & small scale industries.

* Concentrating type of solar collector.

- Concentrating solar collectors collect and concentrate solar radiations on absorbing surface.
- This collectors have some sun tracking devices to follow the sun for maximum collection of solar radiations. Types of concentrating solar collectors.
- Parabolic solar collectors-



- They collect solar radiations & focuses on line or a point. therefore is called as line focussing collector.
- Highly polished glass aluminized plastics are used as reflectors.
- These are used for applications where temp. needed more than 3000°C .

- Advantages -

- They are used in high temp. application.
- High solar radiations collect a efficiency.
- Heat losses are less.
- Pollution Free.

- Disadvantages -

- High initial cost.
- It needs larger maintains.
- Cost of reflector is high.
- It is unreliable.

- Cylindrical solar collector -

- These are used in applications where temp. is below 300°C is required.
- These collectors are used in vapour engine, turbines, heating industries, refrigerators, cooking.

* Comparison between Flat plate type solar collector or non-concentrating type of concentrating type solar collector.

omit

Flat plate type solar collector or non concentrating solar collector.

Concentrating type solar collector.

- | | |
|---|---|
| 1] Solar radiation collection efficiency is low. | Solar radiation collection is high. |
| 2] They are suitable for low temp. applications like - water heating. | They are suitable for high temp. applications like - Power generations. |
| 3] Average temp. is below 100°C . | Average temp. is above 100°C . |
| 4] Cost is low. | Cost is high. |
| 5] Weight is large. More | Weight is less. |
| 6] Maintenance cost is less | Maintenance cost is high. |
| 7] High power storage cost. | low power storage cost. |
| 8] No sun tracking device. | It has sun tracking device. |
| 9] heat losses are large | heat losses are less. |

* Solar power generation-

- Advantages -

- It is renewable form of energy.
- It does not cause pollution.
- No fuels are required.
- It is available in large amount.
- low operating & maintenance cost.
- It is used for local applications.

- Disadvantages -

- It is unreliable.
- large area is needed to obtain power.
- Solar energy is not available during night.
- Solar radiations changes with time of day, month of year.

- Applications of solar energy -

- Solar cooker.
- Solar drying for agricultural products.
- Solar system for electric power generation
- Solar furnace
- Solar photovoltaic cell
- Solar green house
- Solar water heaters

* Wind -

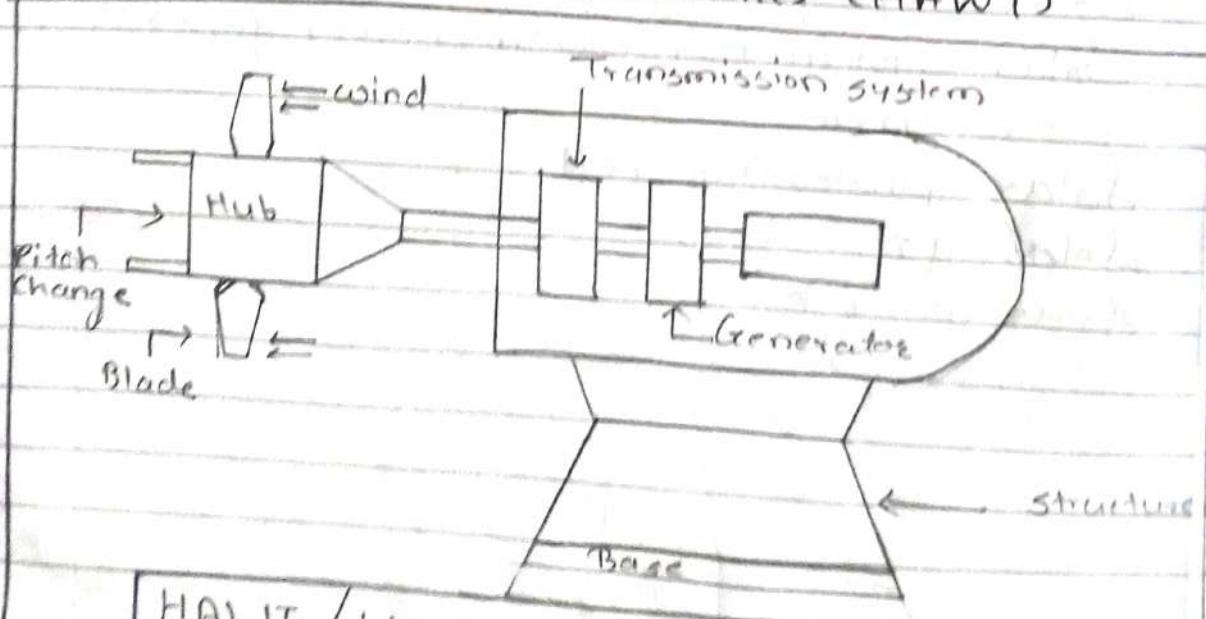
- Wind is motion of air.
- Winds are created due to uneven heating of land & water, because of which a pressure difference occurs.
- Therefore air flows from higher pressure to lower pressure & winds are created.
- Winds are also created due to global heating.

* Power from wind energy.

- Wind having energy due to its motion.
- Any device capable for slow down the mass & speed of air and convert it into useful work. i.e. wind mills.
- The KE of wind = $\frac{1}{2} mv^2$ - Nm.

* Wind turbine generator - (WT). In horizontal axis wind turbines, shaft is horizontal.

* Horizontal axis wind turbines (HAWT)



HAWT / Wind power plant

In horizontal axis wind turbine, axis of shaft is vertical.

Page No.:

(2)

- * Basic components of wind power generation.
 - It consists of wind turbine, transmission system, generator, pitch change, structure and base, hub
 - Wind flows over the blades, turbine rotates.
 - Speed of turbine depends on velocity of wind.
 - The turbine shaft is connected to transmission system.
 - Transmission system is connected to generator.
 - Generator converts mechanical energy into electrical energy.
 - The whole arrangement is supported on a rigid structure & base.
 - Capacity of these power plant is from 0.5 MW to 3 MW.
 - Advantages of wind energy
 - It is pollution free.
 - No need of fuel.
 - Wind is available free of cost.
 - Wind is available in very huge amount.
 - Disadvantage of wind energy
 - It is very difficult to design wind mill.
 - Velocity of wind changes from 0 to ∞ (infinity).
 - Sometimes velocity of wind is insufficient.
 - Maintenance cost is high.
 - Installation cost is high.

- It is located in the hilly & coastal area.
- Electricity transmission cost is high.
- +

Q. Explain wind turbine generator.

Explain wind power plant.

Explain horizontal axis wind turbine.

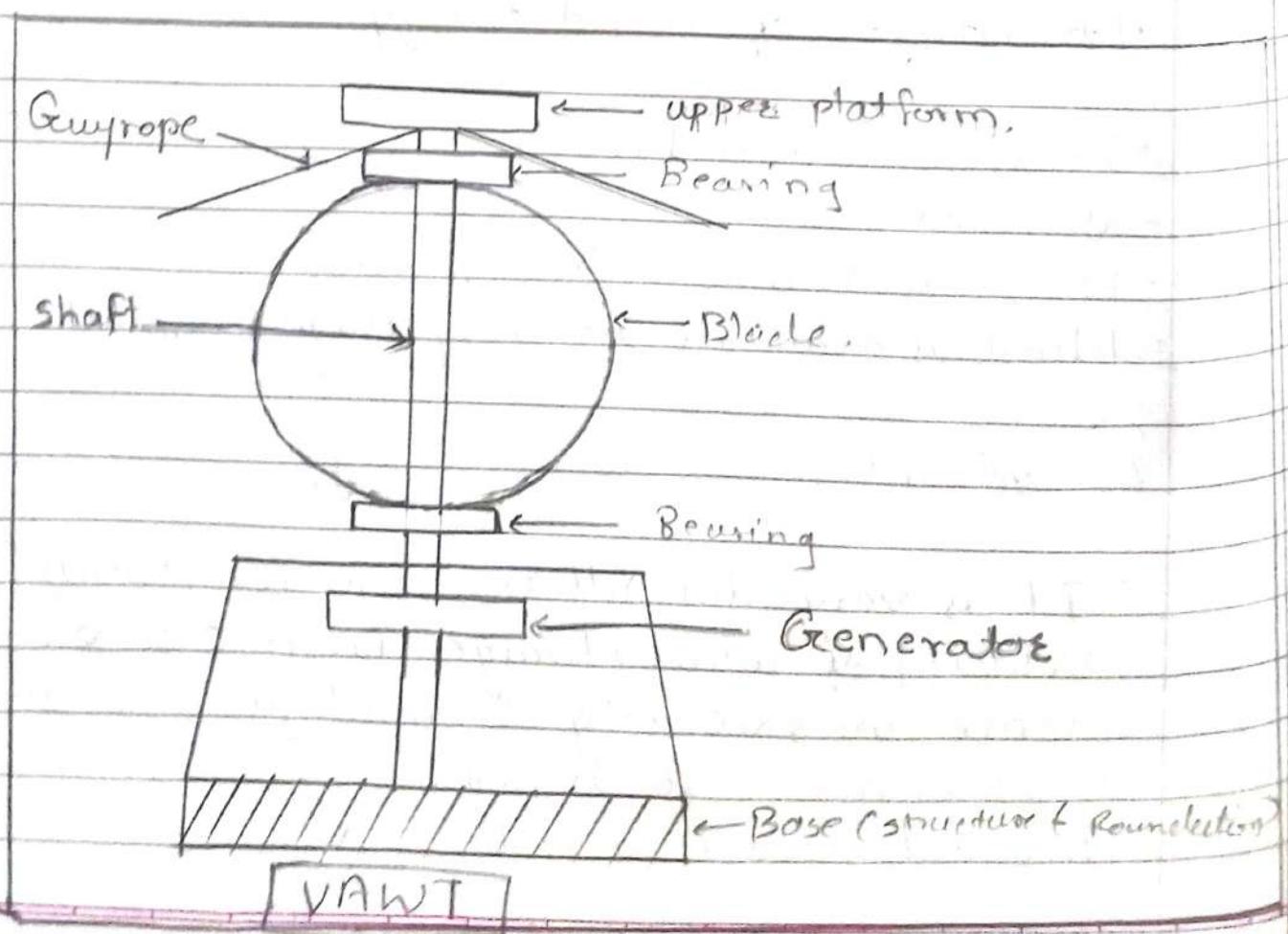
Explain basic components of wind power generation.
(This Questions for above explanation)

* Applications for wind energy /wind power plant.

- It is used to generate electricity

- Small wind mills are used for to pump water.

* Vertical axis wind turbine - (VAWT)



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* Site selection criteria / factors for wind Power plant.

- 1] hilly area.
- 2] Coastal areas.
- 3] Sea areas.
- 4] Soil condition.
- 5] Geographical location.
- 6] Availability of wind.

* Biogas -

It is gaseous fuel. It is produced in a gobat or biogas plant.

- Biogas plant is a device which convert organic matter into a combustible gas.
- Organic matter means cattle dung, wood, leaves, agricultural waste, soil etc.
- Organic matter is converted into combustible gas due to two chemical processes Aerobic & aerobic fermentation.

- Anaerobic Fermentation process.-

Anaerobic fermentation process is occur without oxygen. Organic matter get fermented without oxygen.

- There are two phases.

- 1] liquidification phase
- 2] Gasifying bacteria.

1] Liquidification phase-

- Acid forming bacteria converts hydrocarbanates, proteins, fats into volatile acids & produce CO_2

2] Gasifying bacteria -

- These bacteria work on organic matter with the help of ~~en~~ intracellular enzymes & convert it into methane (CH_4) and carbon-dioxide (CO_2)
- These bacteria are known as methane bacteria.
- Aerobic Fermentation process-

In aerobic process oxygen is supplied to the organic matter for fermentation.

- It consists of three phases -

- 1] Hydrolysis -
- 2] Acid formation
- 3] Methane formation Fermentation

1] Hydrolysis - large pa

large particles of organic matter are reduced to smaller particles which are soluble in water.

- Extra cellular enzymes is produced.

2] Acid formation

Acid forming bacteria convert hydrocarbanates, proteins & fats into volatile acid.

3) Methane Fermentation -

Bacteria convert volatile acid into methane and carbon-dioxide.

* Biogas Plant.

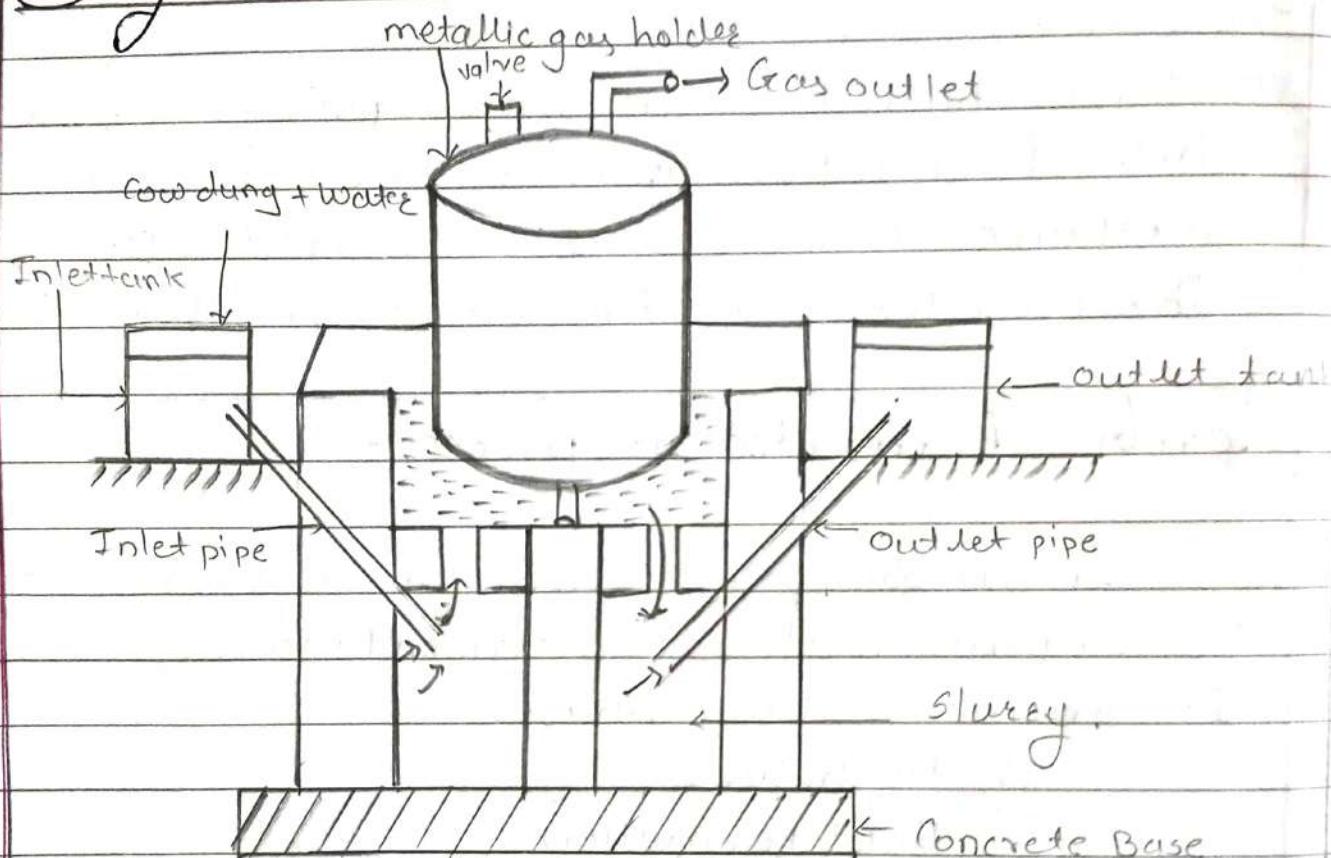


Fig - Biogas plant floating type

Construction

- It consist of inlet tank, outlet tank, inlet pipe, outlet pipe.
- It consist of metallic ~~gas~~ holder with gas outlet
- All plant is built up on strong concrete foundation.

Working -

- At the start inlet tank is fillup with mixture of organic matter and water in the ratio 1:1
- All the air is removed from gas holder.
- Inlet tank is supplied with organic matter as required daily, weakly or till the tank is full.
- It takes 4 to 8 weeks for generation of bacteria and methane gas.
- After some days combustible gas is produced i.e. called biogas.
- At starting the biogas cannot burn smoothly.
- Depending upon organic matter and time of biogas is produced.



Advantages -

- Biogas is cheaper.
- It is useful for domestic use.
- It is pollution free.
- It is useful for rural people.
- The waste from biogas plant is good fertilizer.
- Initial investment cost is less.



Disadvantages -

- Without organic matter gas cannot produced.
- It is limited only for rural people / area.
- Surrounding area of biogas plant becomes dirty & spread smell.

* Biomass -

Organic matter produced by plants & animals like plant waste, animal waste, agricultural waste are called biomass.

- The biomass can be considered as renewable energy sources.
- Biomass are divided in 3 (categorical) types
 - 1] Biomass in traditional solid mass - like wood & agricultural waste.
 - 2] Biomass in non-traditional form like ethanol & methanol as liquid fluid
 - 3] Fermentation of biomass anaerobically to obtain biogas.
- Wood waste & bagasse
- Biomass are bulky & contains large amount of water
- Solar energy → Photosynthesis → Biomass

Energy
generation

* Biomass conversion efficiency.

Biomass can be converted in other fuels by using different technologies.

1] Direct combustion.

2] Thermochemical conversion.

3] Biochemical conversion.

1] **Direct combustion** - The process of burning biomass in presence of oxygen to produce heat, light and other products is called direct combustion.
e.g. - In food, animal waste & agricultural waste.

* Pyrolysis - It is the process in which the organic material is converted into gases, solids & liquids by heating in the absence of oxygen.

2] **Thermochemical conversion** -

Gasification and liquification are two thermochemicals of biomass.

In Gasification biomass is heated with oxygen to produce gas.

- In liquification biomass can be converted into methanol or ethanol. (liquid)

3) **Biochemical conversion** -

It takes two forms anaerobic & aerobic fermentation

- Fermentation is the process of breaking organic matter by bacteria.

* Ocean thermal energy conversion - [OTEC]

only
define
① →

Explain

→
define
explain
q)

- This is the indirect form of solar energy.
- The surface of water of sea act as the collector from solar heat.
- These heat contained in the upper layers of sea.
- These heat is converted into electricity.
- Some low boiling point organic fluid could be heated by warm water to convert organic fluid into vapour.
- These vapours are used to rotate turbines.
- Methods of ocean thermal electric power generation.

□ Open cycle / Claude cycle (ocean thermal electric power generation)

Q Explain Ocean thermal energy conversion. (OTEC)

→ - Construction -

- It consist of flash evaporator, turbine, generator, pump, condensation arrangement & inlet or valve warm sea water.

- Working

- The warm surface water of sea is enter into the generator.
- Heat form warm water is given to low B.P. Fluid like ammonia / propane.

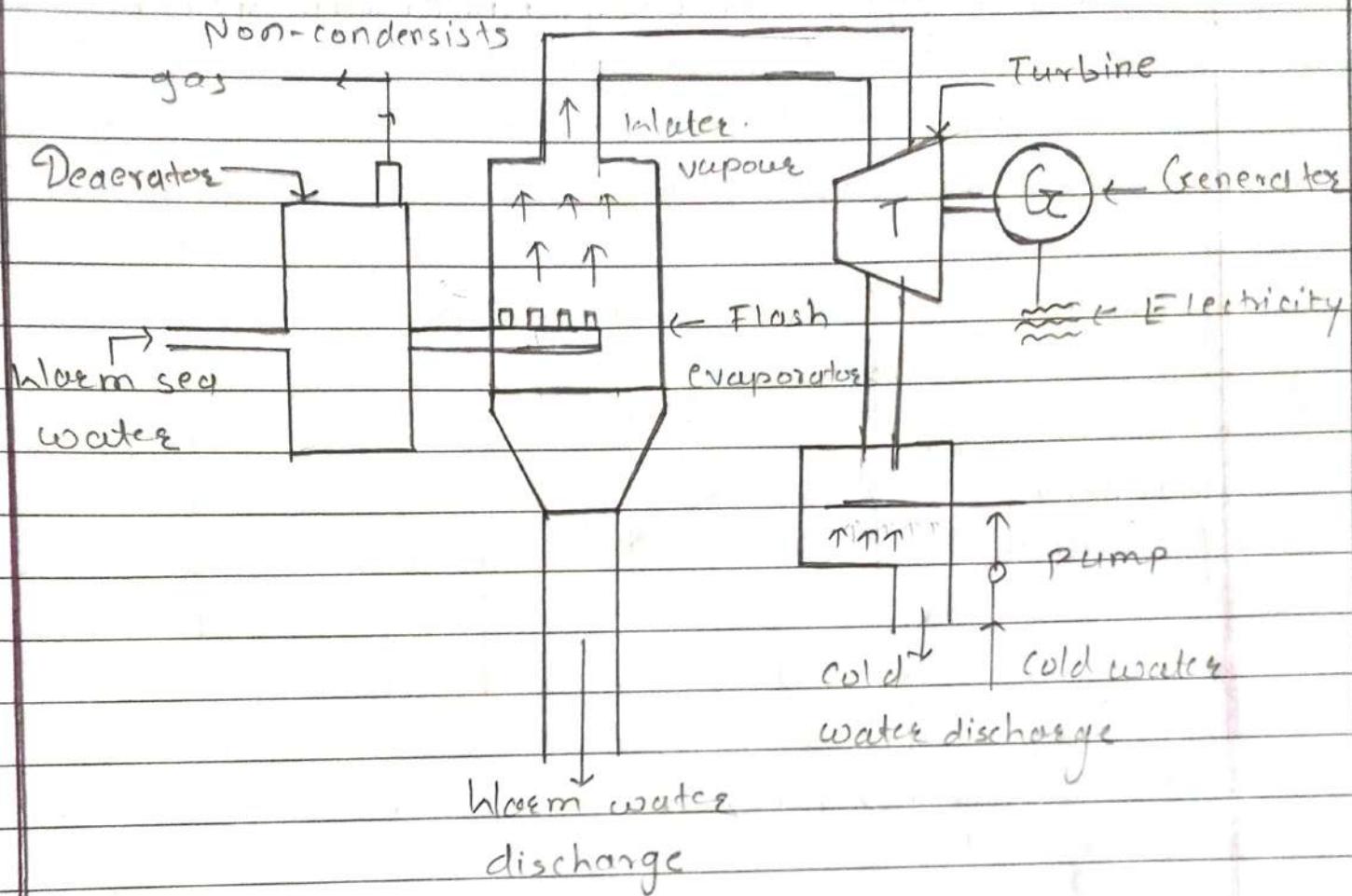


fig - Open cycle OTEC system.

- Ammonia or propane generates steam, steam enters into the turbine.
- This turbines are low pressure operating turbines.
- Turbines are connected to generator, generator produce electricity.
- Steam is converted into cold water by condensation.

2) Closed cycle OTEC. (Anderson cycle)

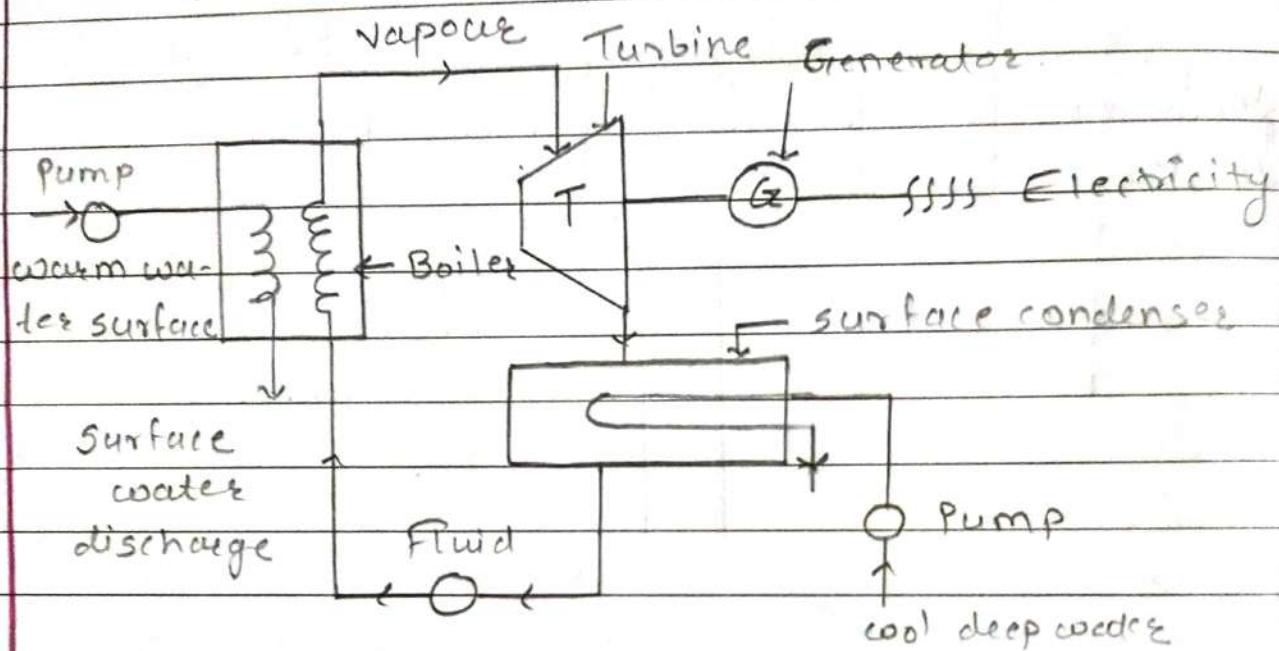


Fig. Closed cycle OTEC.

* Construction -

= It consists of inlet for warm surface water, turbine, generator, surface condenser, pump, back flow arrangement.

* Working -

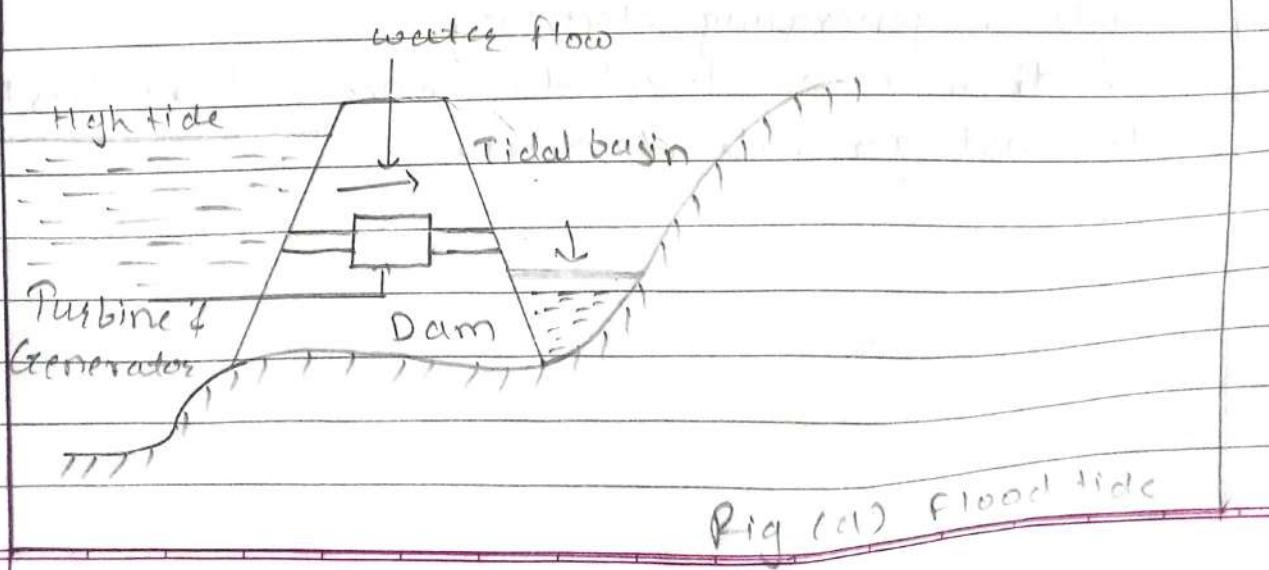
- Heat from warm surface water of sea is transferred to the low B.P. Fluid. such as ammonia or propane.
- This fluid produces vapour, vapours are supplied towards turbine.

- These turbines are low pressure operating turbines.
- Turbines are connected to the generator, generator produce electricity.
- By using surface condenser vapours are converted into fluid.
- This fluid supply to the system.

* Tidal energy -

- Tide is a periodic rise and fall of the water level of sea.
- Tides occurs due to the attraction of sea water by the moon
- These tides can be used to generate electrical power which is known as tidal power.
- When the level of water is above sea level then it is called as flood tide.
- And when the level is below sea level then it is called as ebb tide.

* Tidal energy conversion / Tidal energy plant.



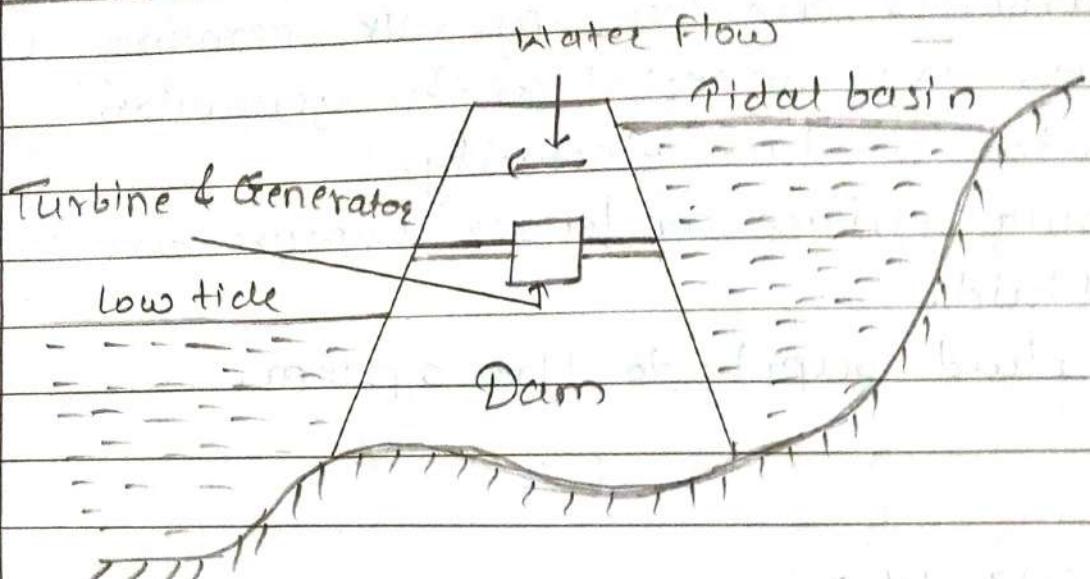


Fig (b) Ebb Tide.

* Working

- Water stored during the flood tide is used to rotate turbine
- at the time of high tide (Flood), level of water is above the tidal basin, Water flows through turbine.
- Turbine is connected to the generator, electricity is generated in generator.
- At the time of low tide. (Ebb), level of water on tidal basin is high.
- water flows through turbine towards low tide , generating electricity.
- IF there is no level difference , then turbine does not generate electricity.

* Advantages -

- It does not require fuel.
- It is free from pollution.
- Initial investment cost is less.
- Space required is small.

+

Disadvantages -

- Efficiency is less
- Generation of electricity is dependent on timing of tides.
- Natural sites are required to establish these plant.

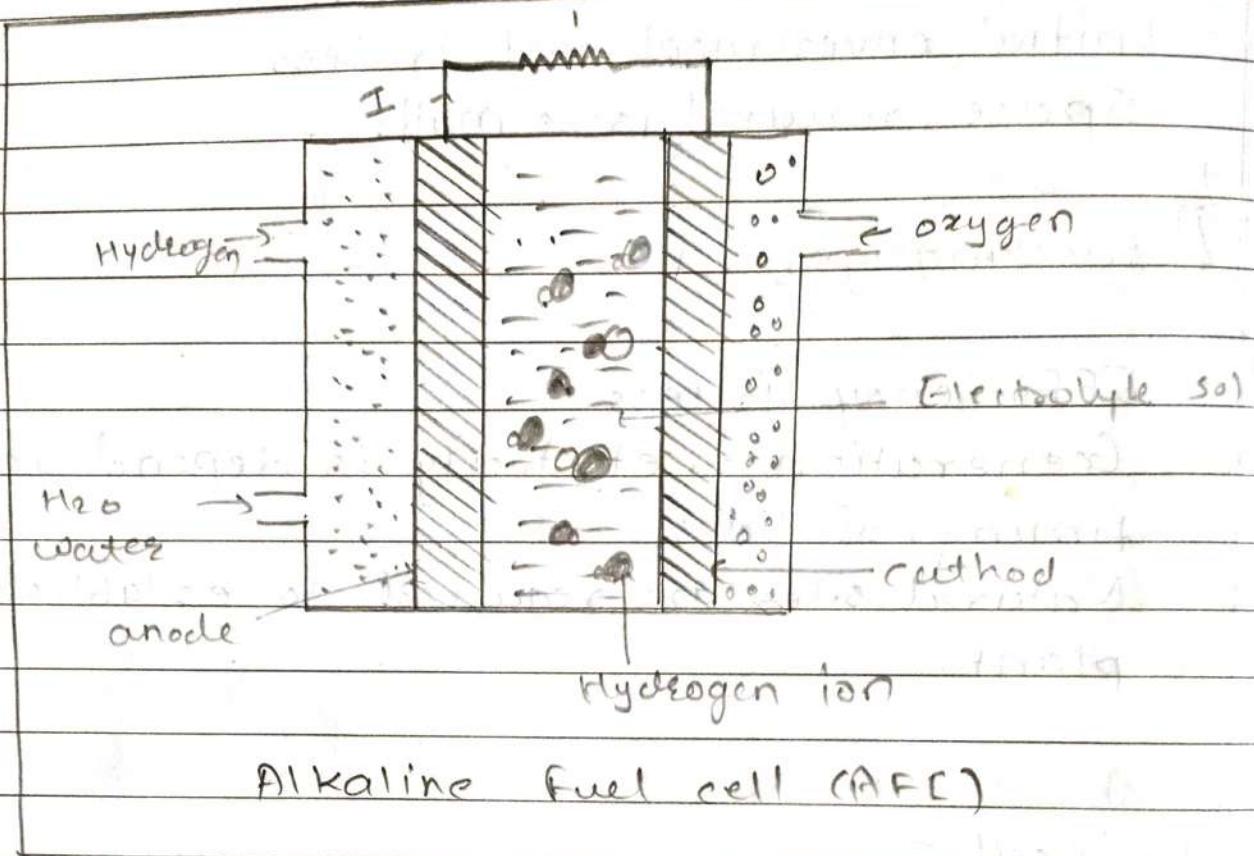
* Fuel cell -

Define -

- Fuel cell is a device which converts continuously chemical energy into electrical energy.
- Fuel cell system requires continuous supply of fuel and generate electricity.
- Fuel cell do not need recharging.
- Fuel cell convert chemical energy directly into electrical energy without intermediate.
- Fuel cell can have almost 90% efficiency.
- Fuel cell do not have moving part.
- Fuel cells are simple & safe.
- Fuel cell is controlled chemical electro energy.

* Principle and operation of fuel cell.

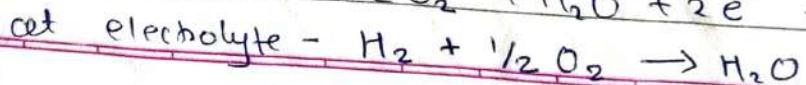
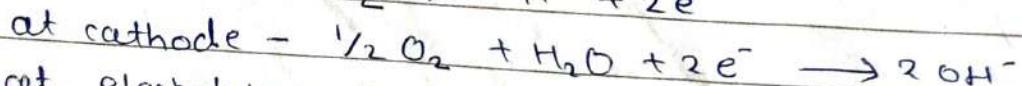
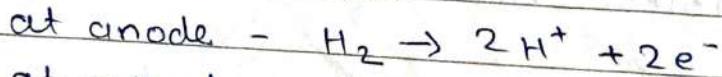
- Alkaline fuel cell (AFC)



Working -

- Hydrogen atoms are supplied from anode while oxygen atoms are supplied from cathode.
- Due to the chemical reaction hydrogen atoms are get ionised.
- An e⁻ gets generated from hydrogen atom if it has +ve charge.
- Oxygen atom picks this e⁻ to & travel towards anode through electrolyte soln.
- At anode it combines with hydrogen ions.
- It uses potassium hydroxide & NaOH as an electrolyte.

Chemical reaction -



* Advantages -

- Fuel cells does not produce pollution.
- Fuel cells are environment friendly.
- Efficiency is high
- Space needed is less
- No cooling water is needed
- Power losses are less.

* Disadvantages -

- High initial cost
- low service life

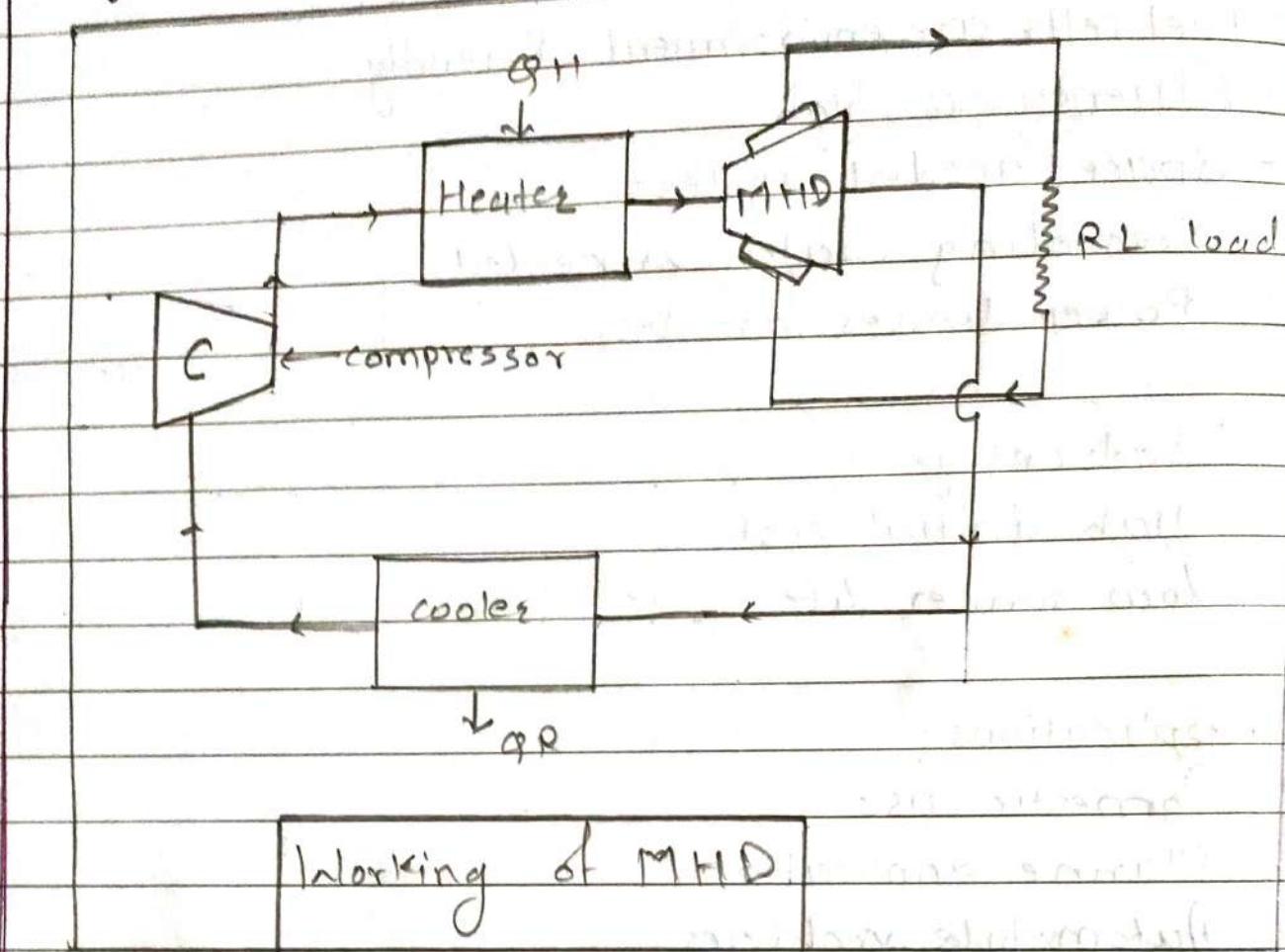
* Applications -

- Domestic use
- Marine application
- Automobile vehicles.

* Types of Fuel cells-

- ① Alkaline fuel cell (AFC)
- ② Phosphoric acid fuel cell (PAFC)
- ③ Molten carbonate fuel cell (MCF)
- ④ Proton exchange membrane fuel cell (PEMFC)
- ⑤ Solid oxide Fuel cell (SOFC)

* Magneto hydro dynamics (MHD)



Working of MHD

- In MHD consists of flow of conducting fluid in the presence of magnetic & electric field.
- The fluid used may be gas at high temp. or liquid at low temp like sodium or potassium
- Heat energy supplied by fuel is directly converted into electric energy without using conventional electric generators.
- The working principle MHD is based on Faraday's law of electromagnetic induction.
- This law states that an electric conductor moving through a magnetic field experiences a retarding force as well as induce an electric field and current.

- To generate electrical energy through MHD on compressed gas or liquid is passed with a high velocity through a powerful magnetic field which generates electric potential in the gas or fluid.
- When the gas or fluid is heated to high temp. the outer electrons escape from its molecules,
- Fluid from MHD is again supplied towards compressor by cooling.

* Advantages -

- Efficiency is high.
- MHD system is highly reliable.
- This system produce power, free of pollution.
- It produce high power in less time.
- The size of plant is small as compared with other power plant.

* Disadvantages -

- Very large magnets are required which are costly.
- Very high operating temp. is required.
- The system having high friction and heat transfer losses.

Q. Explain solar green house-

Chp-3 Energy Conservation

* Contents-

- Scope for energy conservation & its benefits, energy conservation principle, max. energy efficiency, max. vast effectiveness, methods and techniques of energy conservation in ventilation and air conditioners, compressors, pump, fans & blowers, energy conservation in electric furnace, oven & boilers, lightning techniques.

* Introduction-

- Energy is the most imp. requirement and imp. factor for the developement of country
- The Indian energy sector is rapidly growing to meet the demands of the nation
- Gap betⁿ demand and supply goes on increasing day by day, Therefore there is a short of energy.

* Scope for energy conservation-

- energy conservation is defined as the reduction in energy consumption but without sacrificing the quantity and quality of production.
- There should be higher production for same energy consumption.

- Electricity which is mostly shorted should be utilized efficiently.
- Avoid wastage of energy.
- To avoid wastage use of energy, energy audit is required.
- Energy audit is technical survey of a plant where maximum energy is utilized.

* Energy conservation principle -

- There are two principle for energy conservation.
- 1] Maximum Thermodynamic efficiency
(maximum energy efficiency)
 - It is defined as the maximum possible work output by using a given amount of energy input.
 - example- Energy losses in pressure cooker during cooking food.
- 2] Maximum cost effectiveness
 - Maximum work = energy output - energy loss - energy input in transfer discharge

- To overcome the challenges of high energy prices, energy security it become important to improve the energy efficiency cost effectively.
- In industries, hospitals, consume more than 70% of the natural gas & electricity used in the country.

- Therefore it is important to find out effective ways to overcome challenges of high energies.
- Cost effectiveness of energy efficiency is important to find out energy potential
- Energy efficiency cost effectiveness is measured by comparing the benefits of an investment with cost.

* Energy conservation in ventilation and air conditioning - (HVAC)

- Out of the total energy used in manufacture energy heating, ventilation and air conditioning (HVAC) constitutes upto 35%.
- The design of good HVAC system consider the relationship of building system for energy consumption , air quality and environmental benefit.
- HVAC refers to provide fresh filtered air , heating, cooling & humidity control in a building.
- To supply the HVAC system the facilities can have any combination of heating and cooling sources.
- For heating facility gas heat pump , electric heater used.
- For cooling facility air conditioner used.

Ventilation -

- The process of supplying or removing air from a space by natural or mechanical method is called as ventilation.
- The air which is exhausted from the building must be replaced by outside air.
- Window air conditioner is used to distribute air directly from the unit.

Air conditioner -

- Air conditioning is controlling the temp of air and humidity of air , which is further used for diff. applications.
- Air conditioning is required to meet the human comfort condition as well as industrial application.

Air conditioning system -

- It is difficult to select proper air conditioning system
 - A suitable system should maintain correct temperature, humidity , air purity .
 - This system consist of diff. components.
- * Window air conditioner / Room Ac.

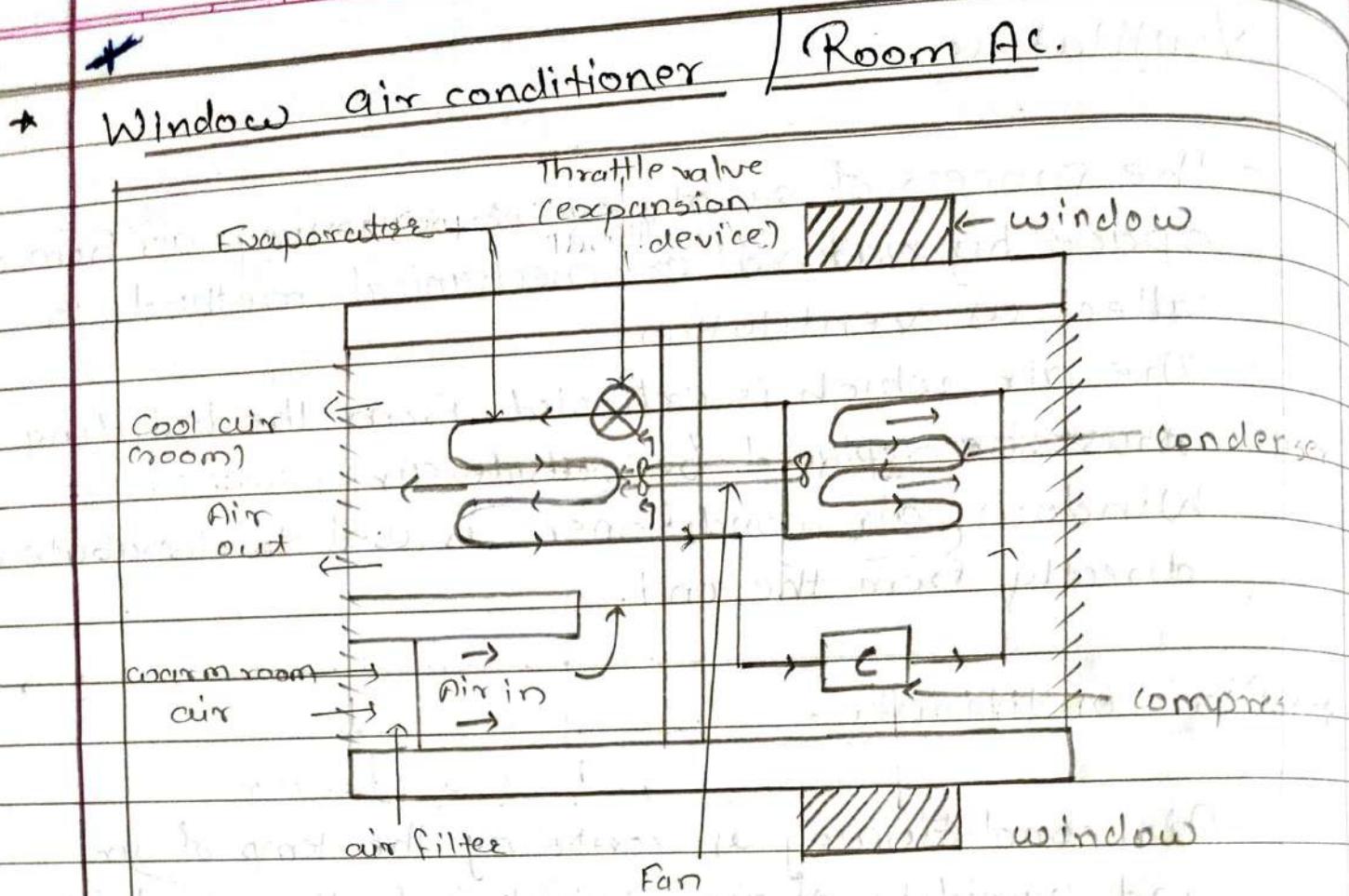


Fig - Room Ac / Window Ac

* Construction -

- Window AC consist of compressor, condenser, evaporator , throttle valve ~~or~~ (expansion device), Fan

* Working

- Refrigerent is compressed in compressor & its temp. & pressure increases
- High temp. & high pressure refrigerent passes through condenser, where it is cooled by atmospheric air.
- In throttle valve temp. & pressure of cooled refrigerent is reduced

- Then it enters in evaporator.
- Evaporator absorb heat from the air & supply cooled air to the room.
- Flow of air is maintained by fan.
- Refrigerent is again passes through compressor, cycle is repeated.

* Split Air Conditioner

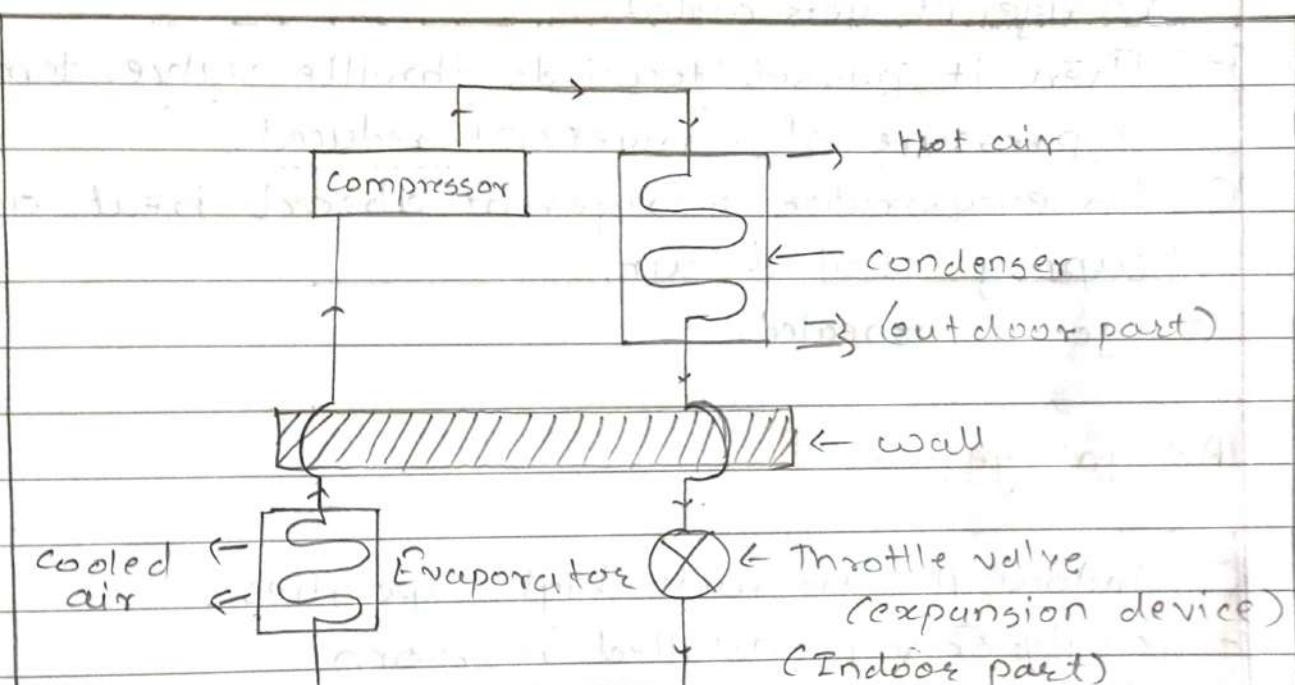


Fig - Split air conditioners

Construction -

- It consists of indoor parts (evaporator, throttle valve (expansion device))
- The outdoor part consists of compressor, condenser
- This type of AC is called as split AC. because

the AC system is split into 2 parts, 1 part is located inside the room and other is outside the room.

Working -

- Refrigerent get compressed in compressor with high pressure and high temp.
- Then it passes towards condenser, in condenser, refrigerent gets cooled.
- Then it passes towards throttle valve, temp & pressure of refrigerent reduced.
- In evaporator refrigerent absorb heat and supply cooled air.
- Cycle is repeated.

Advantages -

- Window AC are with high capacities.
- Easily installed in room
- Size is very small ∴ Installation is simple.
- Manufacturing cost is less.

* Energy conservation in HVAC / AC

- Reduce HVAC system operation when building or space is unoccupied
- Reduce HVAC operating hours.
- Adjust areas that are too hot or too cold
- Reduce unnecessary heating or cooling.
- Install a good HVAC system

- Implement a regular maintenance plan.
- keep door closed when AC is running.

Compressor -

Define - An compressor is a device which takes atmospheric air in (low pressure air), compressor it & deliver high pressure Air to the storage tank (vessel) from which it may be used.

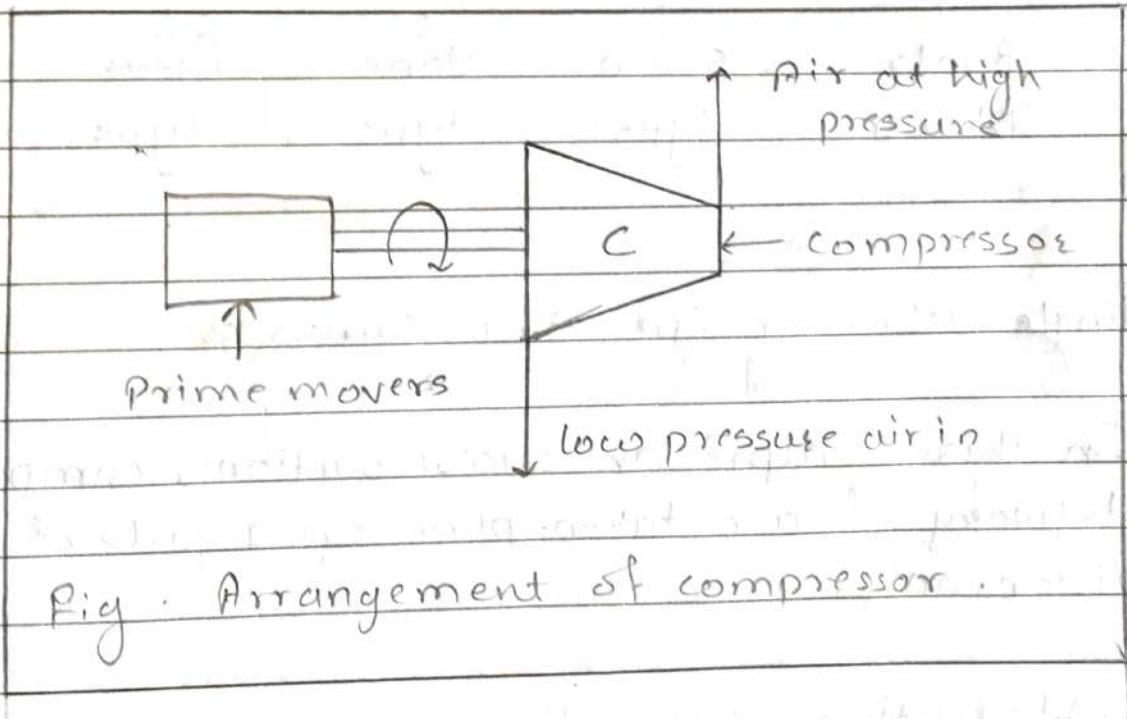
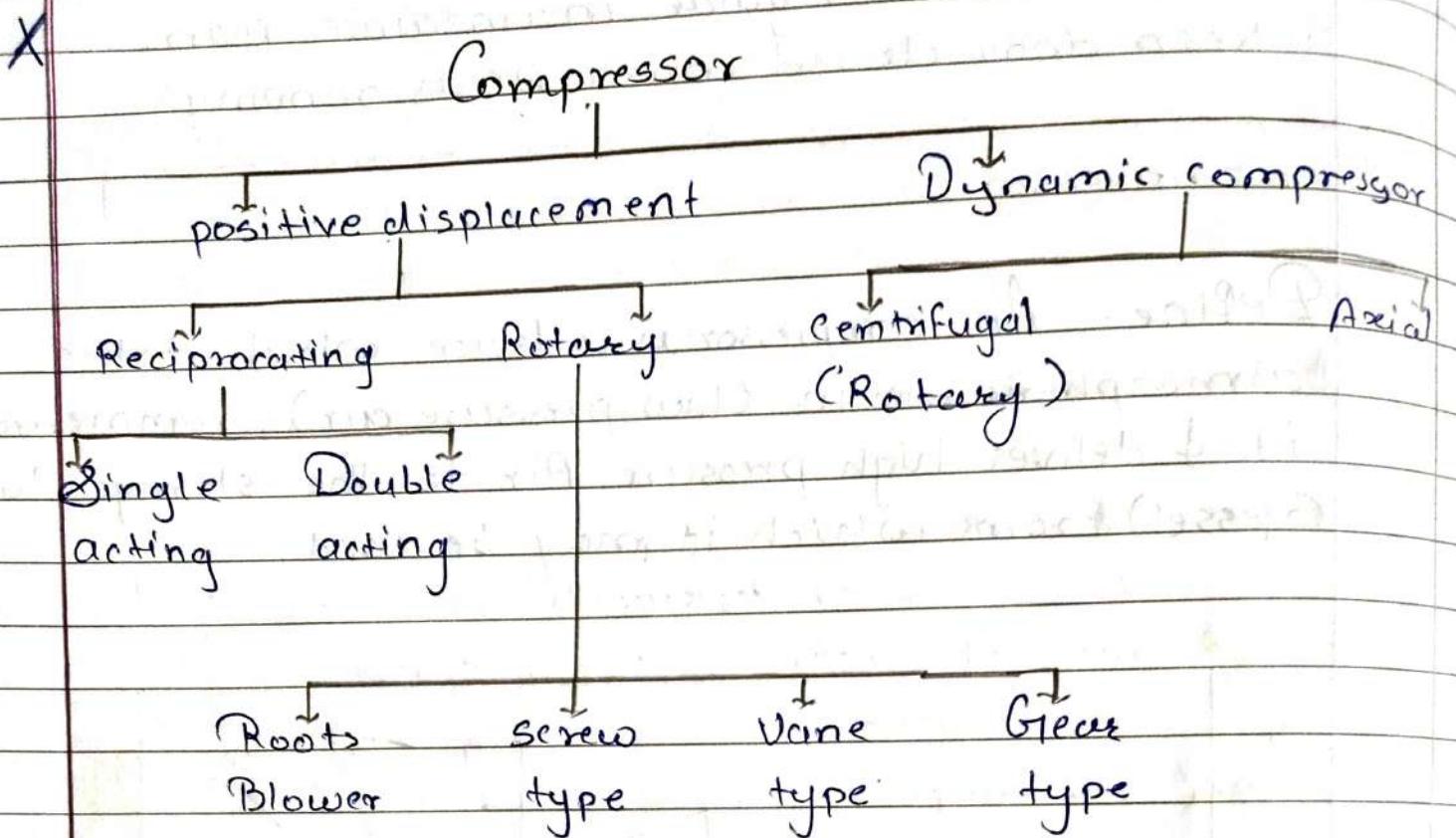


Fig : Arrangement of compressor

* Classification of compressor -



* Single acting reciprocating compressor -

- In this compressor suction, compression & delivery of air taken place on 1 side of the piston only.

* Double acting reciprocating compressor

- In this compressor suction, compression & delivery of air taken place on both sides of the piston.

* Positive displacement of reciprocating compressor

- Piston and cylinder are used for compressing air.

- swept (stroke), volume of piston in cylinder is known as displacement of compressor.

* Reciprocating compressor / single acting reciprocating compressor.

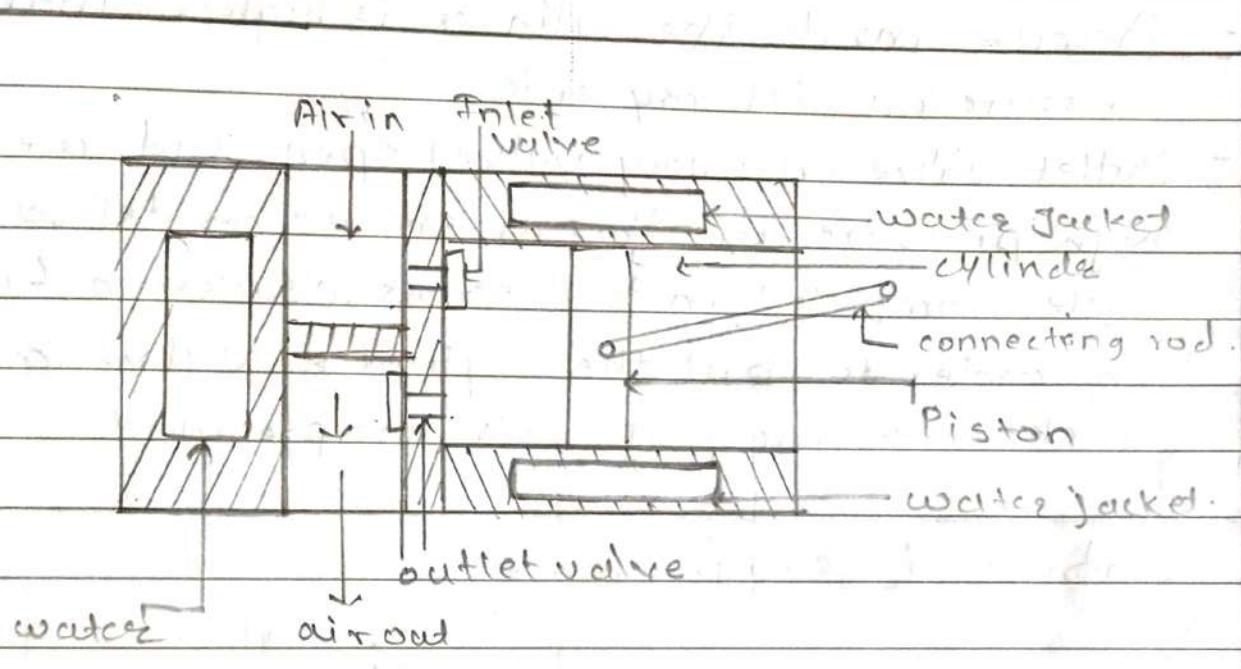


Fig - Single acting Reciprocating Compressor

IDC - Inner dead centre (left side)

ODC - Outer dead centre (Right side)

* Construction -

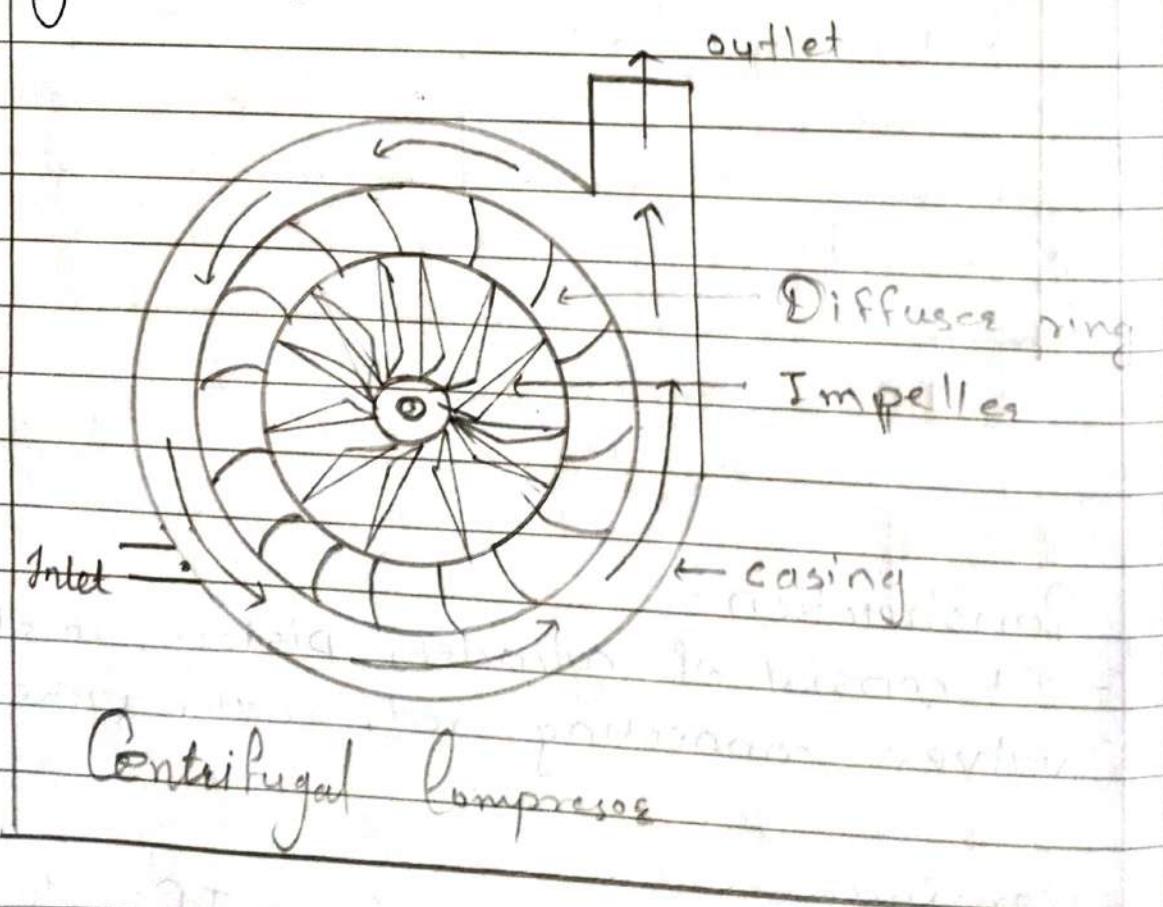
- It consists of cylinder, piston, inlet and outlet valve, connecting rod, water jacket.

* Working.

- When piston moves from IDC to ODC, the pressure inside cylinder falls below atm. pressure.

- ∵ suction valve (Inlet valve) open.
- So air enters into the cylinder. This is known as suction stroke.
- When piston starts moving from ODC to IDC, pressure inside the cylinder increases and suction valve closed.
- Pressure inside the cylinder is higher than the pressure on delivery side.
- Outlet valve (Delivery valve) open and we get high pressure air this is known as delivery stroke.
- Cycle completed in two stroke, ~~①~~ Suction & ~~②~~ Delivery
- In order to ^(oo) cool the cylinder valve cooling jackets or water jackets are provided.

* + Centrifugal compressor-



* Construction -

- It consists of impeller, diffuser, casing

* Working -

- Air enters into the compressor at low pressure from inlet valve at casing or inlet valve at centre of impeller or inlet valve at the top.
- When motor is on impeller starts rotating with high speed.
- Air also starts rotating with high speed.
- Diffuser ring helps to convert KE of air into pressure energy by increasing pressure of air.
- Diffuser gives the path to the air.
- We get high pressure at outlet.
- Casing is provided for air tight chamber.

* Energy conservation in compressor

- Air supplied to the air compressor should be at lower temp.
- Air supplied to the compressor should be dust free.
- Air supplied to the compressor should be moisture free.
- Compressor is provided with intercooler like water jacket or air cooled jacket.

* Fans and Blowers.

- Fan is a mechanical device for moving air or gases for ventilation and other requirement.
- Blowers increase the speed and volume of an air stream with rotating impellers.
- It increase the pressure of air to move it against resistance caused by duct.
- Application of fans are process heating and cooling, electronic cooling, in supplying air in boiler combustion.
- Centrifugal flow of fan, air enters around the centre of the fan and exist around the outside.

Energy conservation in fans and blowers

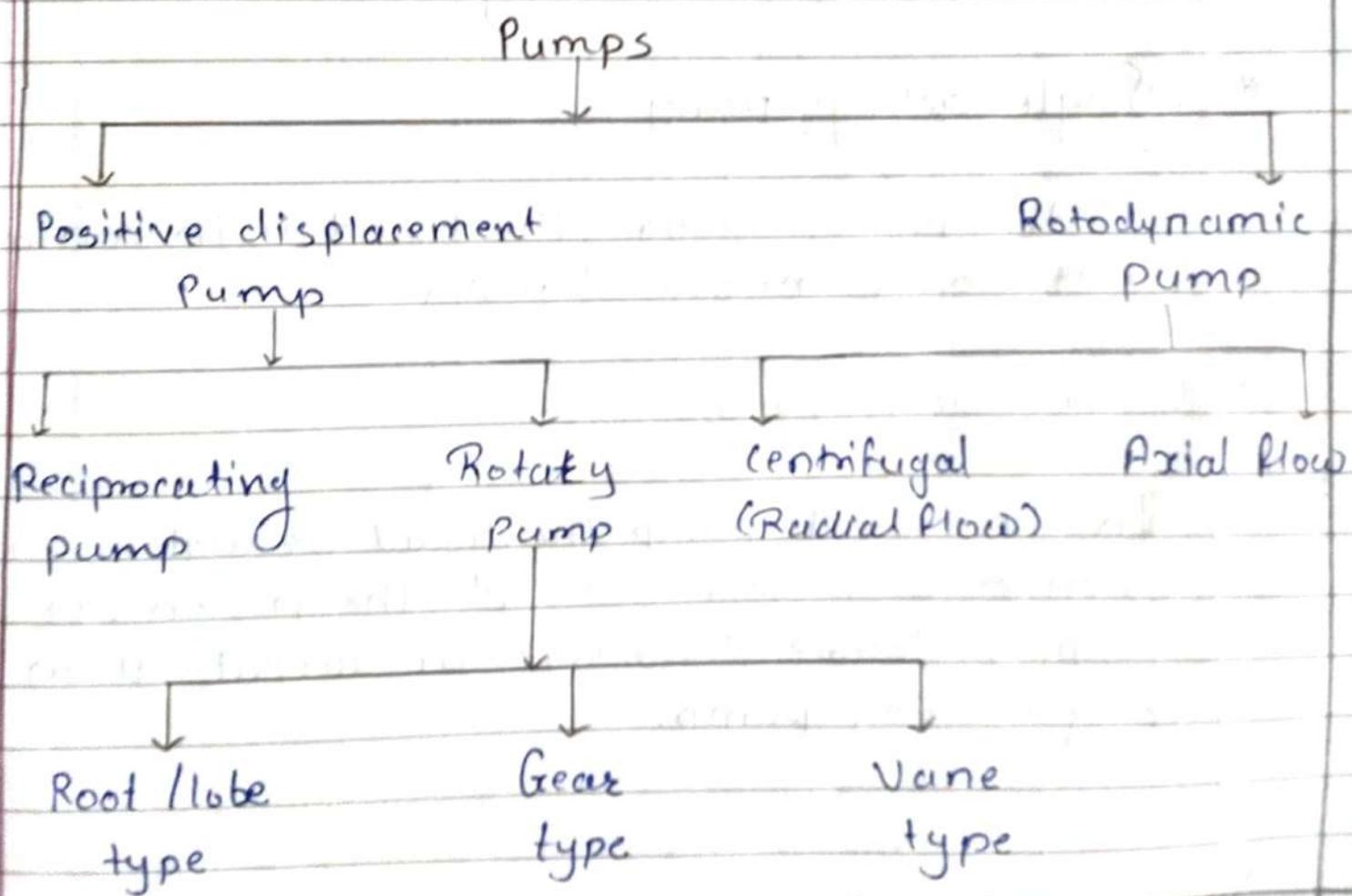
- To reduce energy cost in fans and blowers pressure should be minimum.
- The density of air get affected by temperature, moisture & it affect on energy consumption.
- for energy conservation selection of proper fan is important.
- The design of the fan affect efficiency & power consumption
- The size of the fan affect on efficiency of fan.
- Energy can be conserved in fans and blowers by speed control by using regulators.

* Pump -

Define - Pump is a mechanical device used to lift or convey the water or liquid from 1 place to other place or from lower level to higher level.

- Pumping means adding pressure energy to the liquid or water, to move it from 1 place to other place.

* Classification of Pumps -



* Positive displacement Pump-

- It is a type of pump in which liquid or water is sucked & deliver with the help of piston reciprocating in cylinder.
e.g. - Reciprocating pump.

* Reciprocating Pump-

- It is a type displacement type of pump in which the pressure of liquid or water is raised or increased by piston and cylinder arrangement.

* Single acting pump.

- In this type of pump the liquid is in contact with only one side of piston.

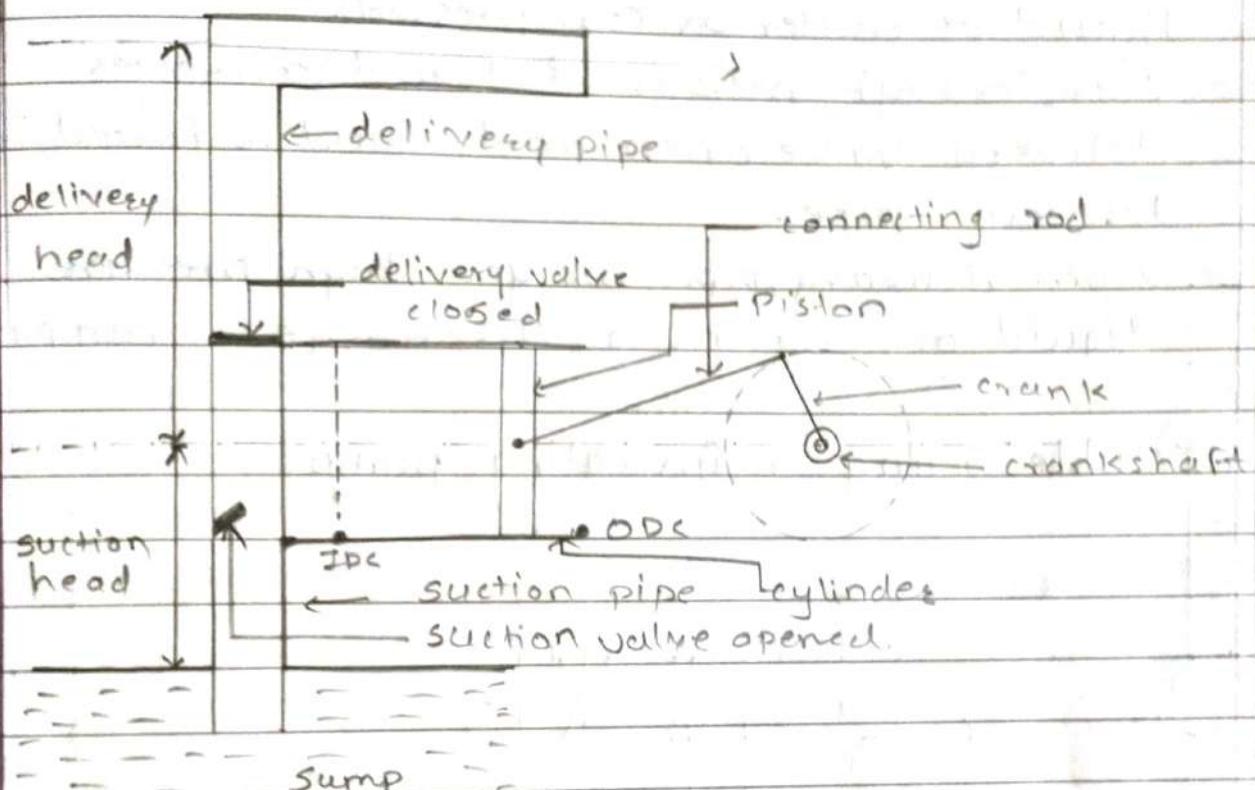
* Double acting pump

- In this type of pump the liquid or water is in contact with both sides of the piston. It supply double discharge or output than single acting pump.

* Single acting reciprocating pump.

* Construction -

- It consist of cylinder, piston, suction valve, delivery valve, section pipe, delivery pipe, connecting rod, crank, crank shaft.



Single acting Reciprocating Pump

ODC - Outer dead centre

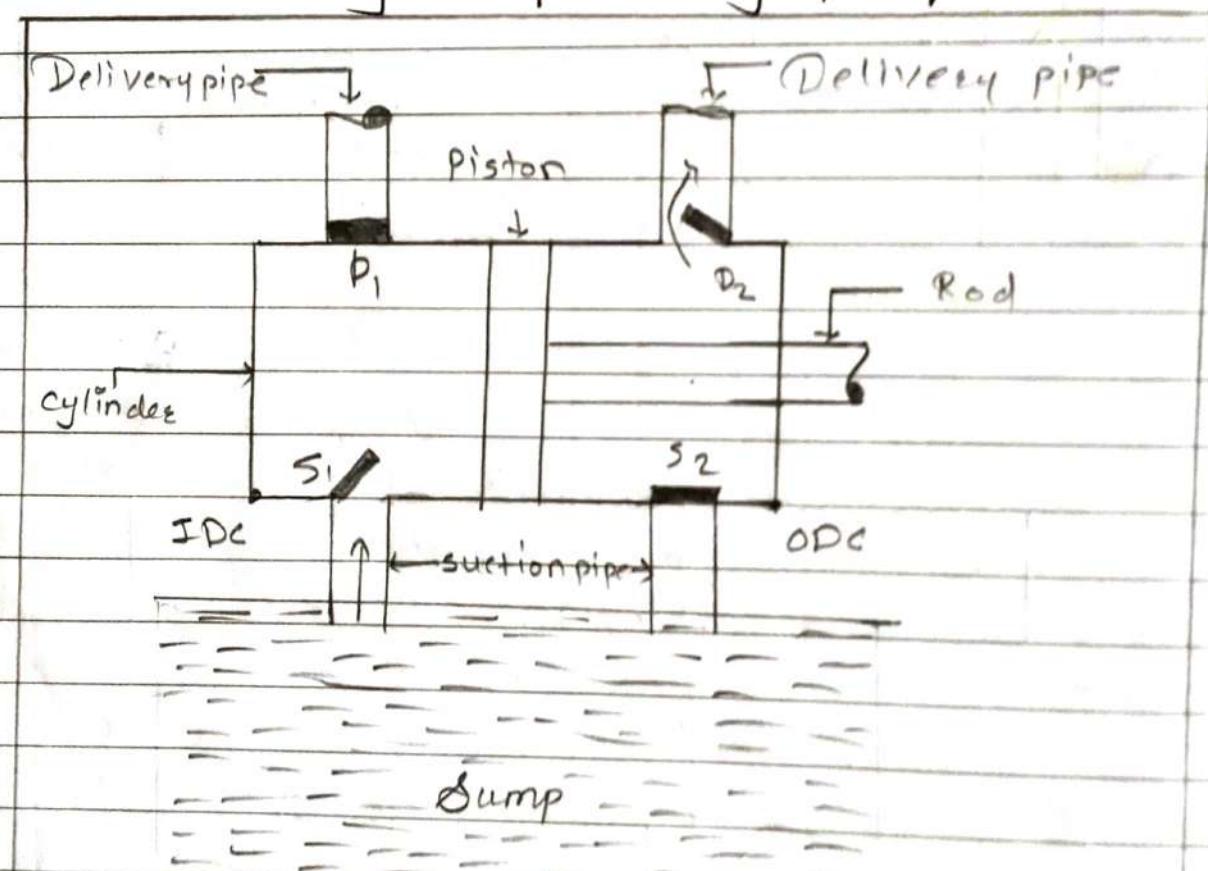
ODC - Outer dead centre
IDC - Inner dead centre

Working -

- As crank rotates piston moves towards right side and vacuum is created on the left side of piston.
 - Due to vacuum suction valve open & liquid or water forced from sump to cylinder

- Rotation of crank upto 180° suction is completed.
- When crank rotates again upto $180^\circ - 360^\circ$, then liquid or water is compressed.
- Due to high pressure of liquid or water delivery valve open and liquid is forced into delivery pipe.
- From delivery pipe we get high pressure liquid or water or discharge or output.

* Double acting reciprocating pump.



Double acting reciprocating pump.

IDC - Inner dead centre (left side)

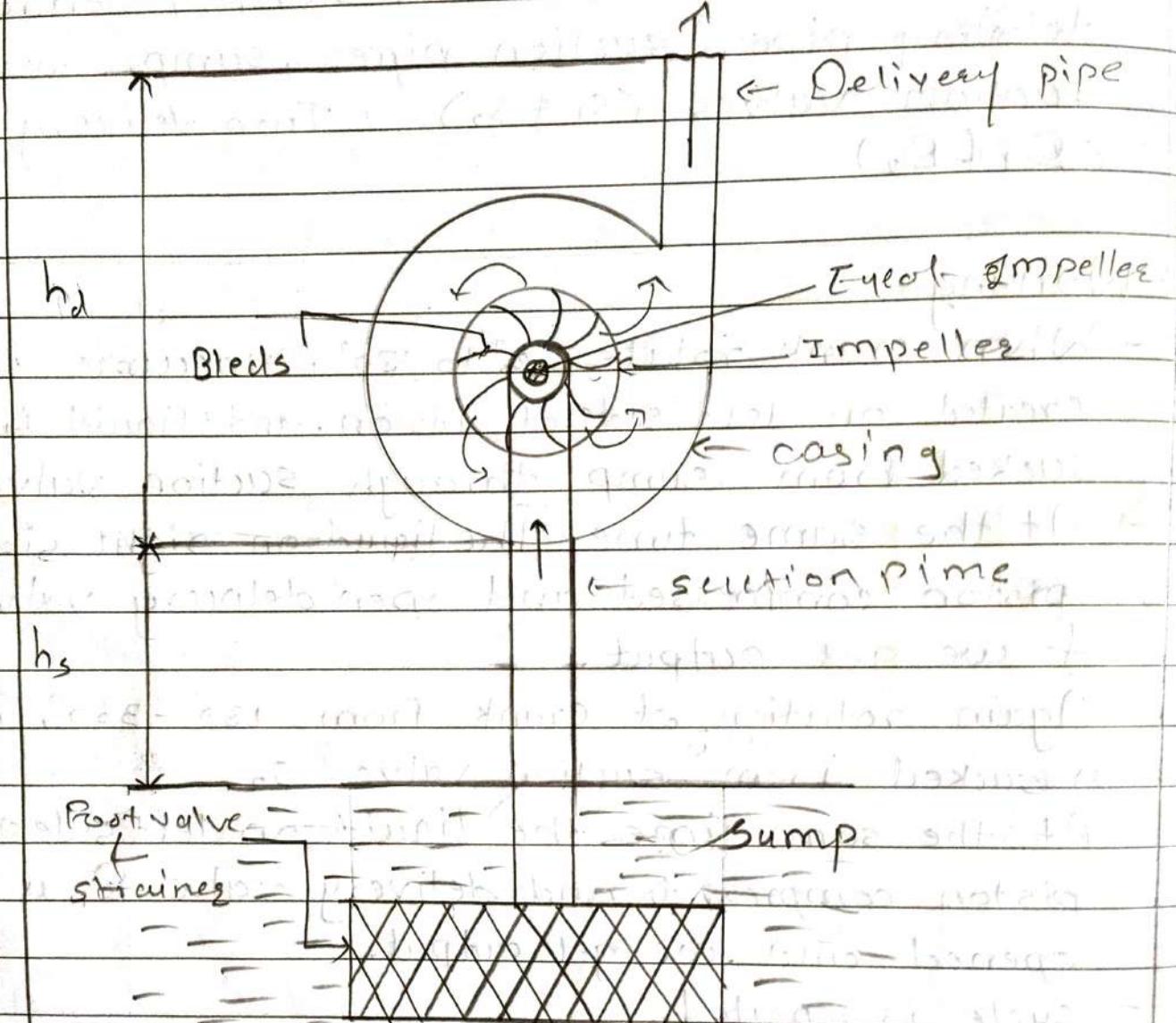
ODC - Outer dead centre (Right side)

- It consists of cylinder, piston, piston rod, delivery pipe, suction pipe, sump, two suction valves (s_1 & s_2), Two delivery valve (D_1 & D_2)

* Working -

- When crank rotates 0° to 180° , vacuum is created on left side of piston and liquid is sucked from sump through suction valve s_1 .
- At the same time the liquid on right side of piston compressed and open delivery valve D_2 , & we get output.
- Again rotation of crank from 180° - 360° , water is sucked from suction valve s_2
- At the same time the liquid on left side of piston compressed and delivery valve D_1 is opened and we get output.
- cycle is repeated.
- It supply double discharge than single acting pump.

* Centrifugal pump.



Centrifugal pump

h_s - Suction head

h_d - Delivery head

* Construction

- It consists of impeller, casing, suction pipe, delivery pipe, foot wall, strainer.

* Working -

- Priming - Before starting the pump it is necessary to prime it.
- Priming is the process of removing air from and filling of the casing, impeller & suction pipe with the water or liquid.
- As the impeller starts rotating centrifugal force is produced.
- This centrifugal force is proportional to the density of liquid or water.
- As density of air is less, the centrifugal force generated, is not sufficient to lift the water.
- Centrifugal force produced by water is sufficient to lift the water because density of water is high than air.
- As the impeller starts rotating centrifugal force is reduced
- Due to this there is increasing pressure and KE of water.
- We get high pressure water from delivery pipe

* Application

- These are suitable for high head & small discharge.
- These are used as a feed pump for boiler.
- It is used fully to lift large quantity of liquid through a smaller height.
- It is used for lifting dirty water, sugarcane juice in sugar factory.
- Centrifugal pump is used in water tube boiler.
- These pumps are used in agricultural purpose & industries.
- These are used in Irrigation system.
- These are used in drinking water supply system.
- These are used in chemical process plant.
- These are used for pumping oil in lubricating system.

* Energy conservation in pump.

- The pump should be operated near best efficiency point.
- The old pump should be replaced by modified and advanced pump.
- To select proper pipe size optimization for pressure reduction.
- For higher heads, taste booster pump should be provided.
- To minimize the fluid losses repair the sit seals & packing.

* Avoid the valve in discharge side.

* Comparison bet' Reciprocating & Centrifugal pump. :-

Centrifugal pump

Reciprocating pump

① low initial & maintenance cost.	High initial & maintenance cost.
② Flow is smooth	Flow is not smooth
③ Low head	High head.
④ High discharge pump	Low discharge pump.
⑤ Torque is uniform	Torque is non-uniform
⑥ Weight is small	Weight is larger
⑦ Compact in size	More space is required.
⑧ Efficiency is low for high heads	Efficiency is high for high heads.
⑨ Pressure is low	Pressure is high.

* Energy conservation in electric furnace -

- The electric furnace are the type of heat producing equipment using electric power.
- An electric furnace used for still making in Rotundary Foundaries for producing cast iron products.
- The furnace are provided with no. of inspection doors, provide insulation over the doors.
- It is to be insure that the furnace chamber should be under +ve pressure.
- Match the load to the furnace capacity.
- Investigate the total cycle time & optimise it.
- The furnace should be provided with temp converts. controls.

* Electric ovens & Energy conservation in electric ovens.

- An electric ovens are used for drying, annealing, curing & baking.
- Energy efficient features on industrial oven can drastically reduce energy used and operating cost.

* Energy conservation in oven.

- Exhaust Exhaust rate adjustment, set them to the minimum necessary.
- heat recovery system, use heat exchangers for recover heat.
- Humidity control system
- Use of insulation, by using insulation reduce oven

heat loss through the ~~wall~~ wall.

- Avoid opening of seal oven
- Use variable speed recirculation.
- Maintain your equipment for energy conservation.

Energy conservation / Energy efficiency in boilers.

- Use air preheater for supply preheat the air to the combustion chamber with heat of flue gasses (exhaust gases).
- Burners, nozzles should be cleaned periodically.
- For proper oil temp., oil heater should be checked.
- To minimize the heat losses use insulation system.
- Use recirculated back water system.
- Clean the doors of combustion chamber regularly.
- Scale and sediment which is formed on the water side must be cleaned.
- The economiser is used to preheat boiler feed water using exhaust heat.
- Recycle the steam condensate from the condenser

From - 1st chp.

Q. Explain steam or thermal power plant with the functions of air preheater, economizer, super heater.

→ 1) Functions of air preheater -

- Air is taken from atmosphere & passes through air preheater, it heated air by using heat of flue gasses or exhaust gasses.

2) Functions of economizer -

- economizer allow to passes only flue gasses or exhaust gasses.

3) Super heater- function -

- Steam is again heated by using flue gasses or exhaust gasses in superheater.

Continue. 3rd chp.

* Energy conservation in lightening system -

- Electric lightening is a major energy consumer.
- Using energy efficiency equipment, effective controls and careful design , it is possible to save large amount of energy.

* Following are the examples for energy saving with efficient lightening.

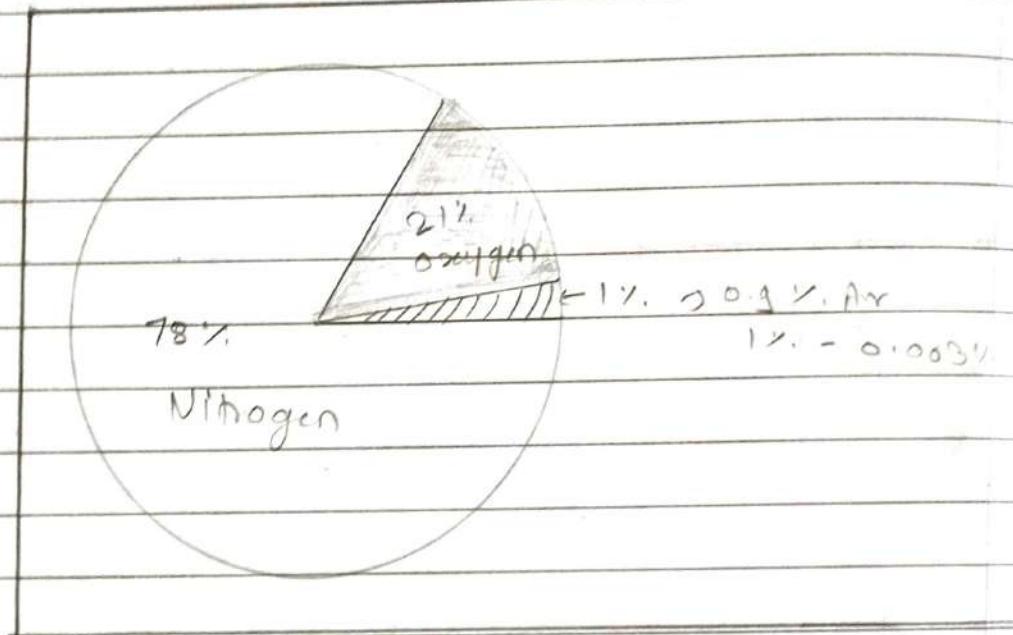
* Installation of compact LED or CFL in place of incandescent lamp

* Whenever possible install sensor to turn light on or off.

- Use key tag system & for electric power.
- Install LED panel
- Use of high efficiency light source for reducing the energy consumption for lightening.

Chap - 11

Air Pollution.



* Definition of Environment.

The nature surrounding us including biotic, a biotic and living & non living things is called environment.

Environmental pollution-

The word pollution originates from a latin word *pollutus*. *Pollutus* means to spoil or making unclean.

Pollution means the presence of substance or the matter which is responsible for imbalance in the environment & can be injurious to living & non living things called as pollution.

types of environmental pollution-

- 1) Air pollution.
- 2) Water pollution.
- 3) Noise pollution.
- 4) Soil pollution.
- 5) Marine pollution.
- 6) Solid waste, E-waste, Nuclear waste.

* Air pollution -

Air pollution is contamination of air due to release of harmful gases and particles in it.

- harmful gases & particles changes the biological and chemical characteristics of natural air, which is adversely affects on living and non-living things in the environment.

Air pollutants -

Air pollutants are the gases and particles present in the atmosphere, causing harmful effects on organism, climate, non-living things.

Classification of pollutants.

Pollutants are classified into two types.

- ① Primary air pollutants.
- ② Secondary air pollutants.

① Primary air pollutants.

They are directly generated from primary sources e.g.- Sulphur dioxide emitted from sugar factories.

carbon monoxide (CO) , SO_2 , CO_2 & NO_x

② Secondary air pollutants-

They are generated by reaction of primary air pollutants.

e.g. - smog created due to reaction of several primary pollutants.

- SO_3 , O_3 (ozone) , HNO_3 , H_2O_2 , these are the secondary pollutants.

* Carbon-monoxide [CO]

- Carbon monoxide is colourless and odourless gas
- It is generated due to incomplete combustion of fossil fuel. near about 60% of CO emission is due to vehicle exhaust.
- It causes heart disease , breathing problem & reduce oxygen carrying capacity of blood.

* Sulphur-dioxide [SO_2]

- It is highly reactive colourless gas.
- About 70% of SO_2 is emitted from industrial power plant. also volcano's contain small amount of SO_2 .
- It causes skin cancer , breathing problems & acid rain.

* Nitrogen oxide [NO_x]

- This are formed due to complete combustion of fuel
- It is reactive gas.

- This gas reacts with air and produce smog.
- It causes coughing problem, damage to lungs, irritation to eyes and nose.

* Suspended Particulate Matter (SPM)

- Particulates like dust, ash, solids carbon produce due to burning of fossil fuel like coal & oil.
- Size of SPM is generally less than 100 μm
- SPM causes cough and cold problem also it affects on lungs.
- SPM causes corrosion of metal parts of the power system.

* Ozone (O_3)

- Ozone gas is present in stratosphere about 16 to 20 km from earth.
- It protects all living things from harmful UV radiation.
- Ozone acts like secondary pollutants as it react with sunlight, heat, nitrogen oxides and carbon compounds.
- Ozone causes cough and Asthma problems. also it affects on eco-system.

* Volatile organic compound (VOC)

- They are carbon based chemicals, which are easily get evaporate at normal temperature and pressure.

- This means that they easily become gases.
eg. household paints, waxes, varnishes
due to them air get polluted & causes various breathing, coughing problems.
- They also formed ozone smog

* Classification of air pollution

- air pollution is classified into 2 types

① Indoor air pollution.

② Outdoor air pollution.

① Indoor air pollution -

It is release of particulates, carbon dioxide and other pollutants carried by indoor air

examples

① household products & used chemicals like washing powder, colour paints, floor cleaning liquid, detergents & shoes polish.

② Building materials like lead, asbestos, formaldehyde.

③ Indoor animals like dog, to mouse, cockroach

④ Tobacco smoking

② Outdoor air pollution -

- It is because of suspended particulate matter, carbon dioxide and other pollutants carried by and take place outside of the indoor structure.

- Fine particulates released due to burning of fossil fuel like coal & petroleum products.
- Gasses like CO₂, sulphur dioxide, Nitrogen oxide and chemical vapour.
- Ozone which is biproduct of reaction b/w oxygen and other primary pollutants.

Causes / Sources of air pollution:-

There are two types of sources

- ① Natural sources.
- ② Manmade sources.

① Natural sources -

- ① Volcanoes
- ② Forest fire
- ③ Decomposition of organic material

② Manmade sources / causes -

① Exhaust from Industries -

Manufacturing industries throughout considerable amount of SO_x, CO, NO_x, hydrocarbons, organic compounds, and chemicals, in to the air which causes air pollution.

② Agricultural activities -

Insecticides, Pesticides, and fertilizers are used in agricultural activities. They emits ammonia gas into the environment which causes air

pollution.

③ Burning of fossile fuel-

Burning of fossile fuel result into emission of Sulphur-dioxide. use of vehicles like two-vehicles, 4-Vehicles, trains, and Aeroplanes causes air pollution. mining operation

④ Mining Operation-

In mining meanerals below the earth are taken out by using large equipment.

During this process dust and chemical particles are released into the air which causes air pollution.

⑤ Thermal power plants-

In India near about 70% of consumed energy is generated by burning of fossile fuel like coal, gas and oil. This power plants emits various gases like sulphur dioxide, carbon monoxide & carbon-dioxide, which causes air pollution.

⑥ Wood fuel-

Wood is burned for cooking & heating purpose in house which causes indoor air pollution.

⑦ Use of wall paints, detergent, floor cleaning liquid, shoes polish are causing indoor air pollution.

* Effects

- 1) Effects at global level.
 - a) Global warming.
 - b) Acid rain.
 - c) Ozone layer deflection.
 - d) Green house gas effect.

a) Global warming :-

Air pollution causes global warming. It causes increase in temp. ice from colder region north and south pole is melting down which increase the sea level. It also leads to displacement and loss of various habitats.

b) Acid rain :-

Due to burning of fossil fuel nitrogen oxides and sulphur dioxide are released into the atmosphere. during rain these air pollutants are getting mixed with water droplets and become acidic due to decrease in pH level then they fall on ground in the form of acid rain.

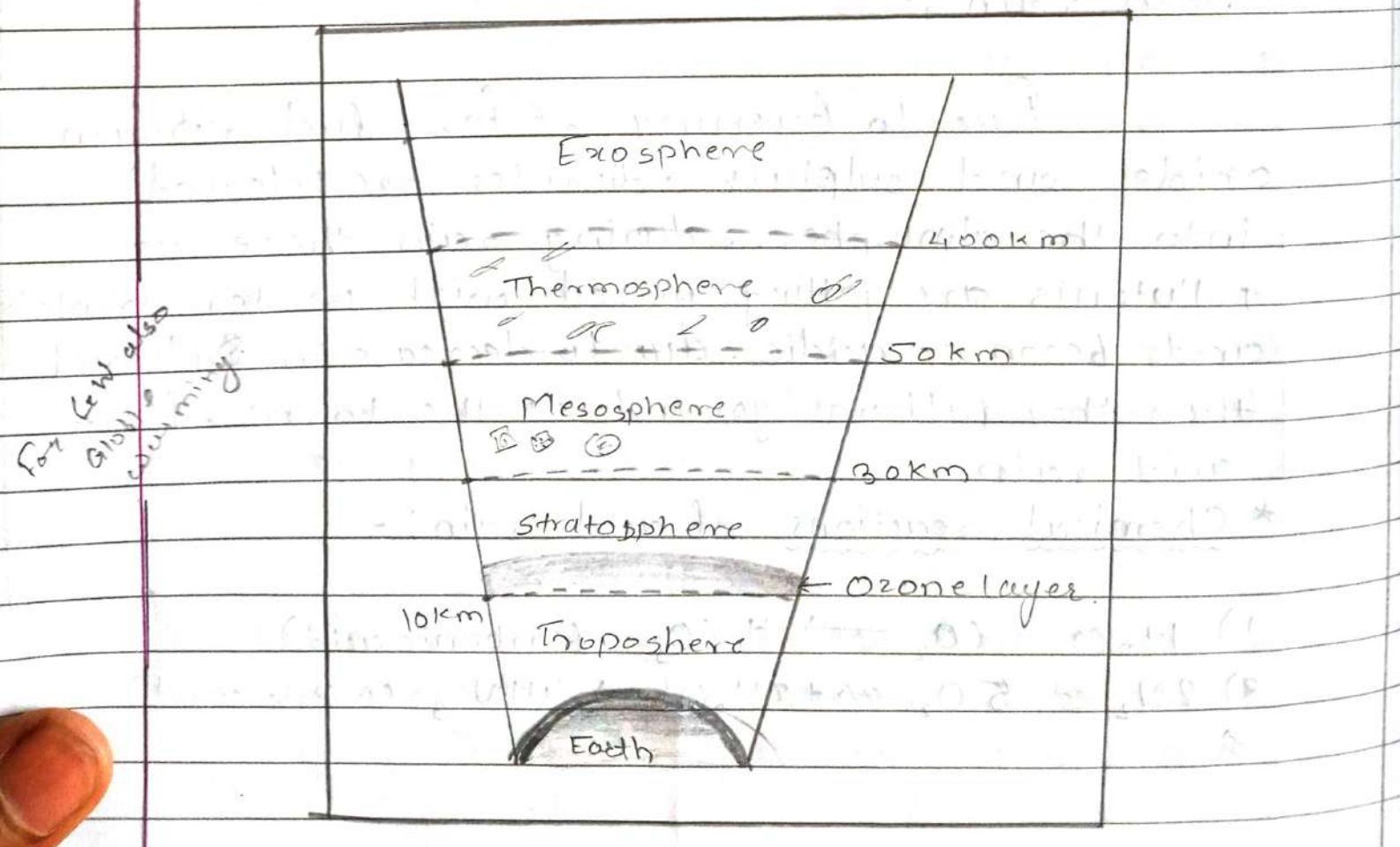
* Chemical reactions of acid rain:-

- 1) $\text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{H}_2\text{CO}_3$ (carbonic acid)
- 2) $2\text{N}_2 + 5\text{O}_2 + 2\text{H}_2\text{O} \rightarrow 4\text{HNO}_3$ (nitric acid)
- 3)

* Effects of acid rain

- Acid rain affects on human being, trees, plants and non-living things.
- Acid rain damage the human lungs resulting into Asthma.
- Acid rain lowers down the visibility in human.
- Acid rain causes damage to trees and plants It changes their growth rate.
- Acid rain affects the fertilization and seed development and fruit formation of trees.
- Acid rain affects on manmade materials like building materials, stones, Metal, Paint etc e.g. Tajmahal.

c) Green house gas effect :-



* Green house gases.
CO₂, methane, Nitrous oxide, hydrochloro carbon sulphur hexafluoride, sulphur dioxide, ozone & water vapours are included in green house gases.

- The atmosphere is divided into 5 layers.
- Whether occurs in troposphere layer.
- Stratosphere contains ozone layer which observe absorb harmful UV rays.
- In Mesosphere rock segments are burns.
- Space shuttles are orbiting in thermosphere layer.
- Atmosphere merges to space in exosphere layer.

Green house gas effects is increase in rise in the atmosphere temp of the earth which causes global warming and climatic changes in the environment because of various green house gases.

Eutrophication :-

It means high amount of nitrogen contains pollutants get developed on sea surface and turn themselves into algae. this algae affects on fish, plants and other animals in water bodies.

i) Deflection of ozone layer.

- Ozone layer is present in stratosphere protects human and animals from harmful UV rays.

- Due to chlorofluoro carbon (CF₆) Ozone layer is deflecting.
- The deflected ozone layer allows UV rays to the earth which will causes skin and eye related problems.
- UV rays also effects on growth of plants and trees.

* Effects of global warming :-

- * Increase in sea level :- Increase in temp. of earth result into ice melting and thermal expansion of ocean which increases the sea level.
- * Effects on water resources:- Due to global warming rainfall patterns are changing. In some places excess rainfall occurs, while in some places no rainfall occurs with this period of rainfall occurrence is changing.
- * Effects on agriculture and forest :- Due to global warming rainfall & temp of region gets change, resulting in reduction in crop yield & forest growth.
- * Effects on eco-system :- Due to global warming many animals and species are having adopting various problems, which result into their extintion. exsistance

health.

- * Effect on human - Due to global warming crop & fruits are becoming more common. This increases the water born disease & infection.
- * Effects on human being - Due to lead kidney failure is occurred in human beings. Due to mercury gastro, skin diseases are occurred in human being. Due to Cadmium irritation of lung, lung cancers & kidney damage are occurred in human being.
Due to Arsenic skin problems, nervous disorders hair fall are occurred in human beings.
Due to SPM (suspended particulate matter) various lung problems & breathing problems are occurred in human being. Due to O_3 infection like cold, cough and Asthma are occurred in human being. NO_x long term intake of NO_x reduce lung function of human being.
 $SO_2 \rightarrow SO_2$ causes eye irritation breathing problems, Asthma, and heart attack.
 $CO \rightarrow CO$ reduce oxygen carrying capacity of blood.

* * Effects on trees and plants

Due to air pollution gases like NO_x , SO_x which are adversely affects on physical & chemical charac. of trees & plants.
air pollution reduce crop yield of plants,

productivity, growth of trees and plants.

* Effects on non-living things

Due to air pollution various gases (green house gases) affects on non-living things in the environment. This gases affects on building material, stone, paints & metals.

e.g. :- Tajmahal.

* Control measures of air pollution:-

- 1) Plantation of more & more trees.
- 2) Use of public mode of transportation:-
people should be encourage to use public mode of transportation to reduce the air pollution.
- 3) Car pooling:- People living in same area or in same locality & having same office can share the vehicles to save the energy, which is indirectly reduce air pollution.
- 4) conserve the energy:- switch off the fan, T.V. and lights when not in use. which reduce the electricity demands on power utility.
So utility use less fuel to generate electricity
This will result into reduction in air pollution.
- 5) Clean energy resources:- Put large amount of emphasis on energy tech. like solar, wind, & geothermal energy. Governments are given many subsidies to private power producers who are involved in generation of power.

Renewable energy sources. This will result into reduction in air pollution.

b) Use of energy efficient devices - Try to use energy efficient devices to lower down the energy consumption.

e.g. - Use of compact Flurosent lamp (CFL) & light emitting diode (LED). Use of

c) Use of engines - Instead of gasoline engines reduce air pollution

* Laws and regulations:-

- As per air act 1981 which is made by govt. of India polluter must be pay fine or penalty to the govt. so to control air pollution people must be aware of rules and regulations of air pollution.

- Public awareness:- People are unaware about the pollution and their effects. A professional society should be developed for creating awareness and changing human behaviour.

- To control air pollution in industries following pts. must be adopted.

+) Industry should be outside of the city.

+) Industry should be develop about 33% of area by green belt

+) Increase the height of the stag.

+) For sugar industry required min. 65m stag height

+) Industry should be used various air pollution control devices or equipment like

- 1) Gravity settling chamber ✓
- 2) Cyclone separator ✓
- 3) Fabric filters ✓
- 4) Inlet scrubber.
- 5) Electrostatic precipitator [ESP] ✓

1) Gravity settling chamber :-

It works on gravitational force principle, in that carrier gas velocity is reduced by which particulates in gas or solid pcls. in gas flow are settle due to gravity.

- These particulates are then removed by hoppers
- This method is commonly used to remove the particle having size above 50μm

Advantages :-

- Simple method
- Construction is very simple
- low maintenance cost .

Disadvantages :-

- It needs large space
- Efficiency is low.

2) Cyclone dust collector / cyclone separators :-

It does not have any moving part.

- Here inlet gas flow is converted to confirm vertex form. it drives
- It drives suspended particles to the wall due

(2)

to centrifugal force. This method is used in cement industry, textile industry & wood industry.

Advantages :-

- Simple construction & operation
- low initial cost
- less maintenance

Disadvantages :-

- less efficiency.
- Equipment deterioration

3) Fabric filters / bag filters.

It is most commonly used & oldest method. Filters are classified as bag filters & fabric filters.

- In bag filter fibers are packed inside the metal enclosure.
- In fabric filter fibers are arranged in thin layer. Fibers are made up of synthetic methods. In this method particles are collected by impaction and diffusion.
- This method is used in cement industry, Paint industry, foundry.

Advantages :-

- High efficiency.
- Remove 10 µm size particles
- Simple in construction & operation.

Disadvantages :-

- High initial cost.
- High maintenance cost (Fabric replacement cost)

4) Electrostatic precipitator :- ESP.

It is commonly used to control particulate emission at industry. It removes particle having size less 0.1 µm. It uses electrical energy as a help to remove particles.

- Here gas flow having aerosol is allow to pass betⁿ two electrodes.
- A considerable potential difference betⁿ two electrode is maintained.
- Aerosol particles get deposited as precipitates at low potential electrode, thus aerosol particles in gas flow are electrically charged. and due to electric field they are separated from gas flow.
- This equipment is measurly used in sugar industry & thermal powerplants.

Advantages:-

- High collector efficiency about 99.9%
- low maintenance and operation.
- Very less treatment time.

Disadvantages:-

- High initial cost 1.5 to 2 cr.
- Space required is more.
- Possibility of explosion hazards during process.

5) Wet scrubber

Here liquid is used to remove particles from the gas. Mostly water used as scrubbing liquid.

- Dust is mixed with water to separate out the dirty gas. This is very simple method.
- This method is used in food processing industries, sugar industries, foundry

Advantages:-

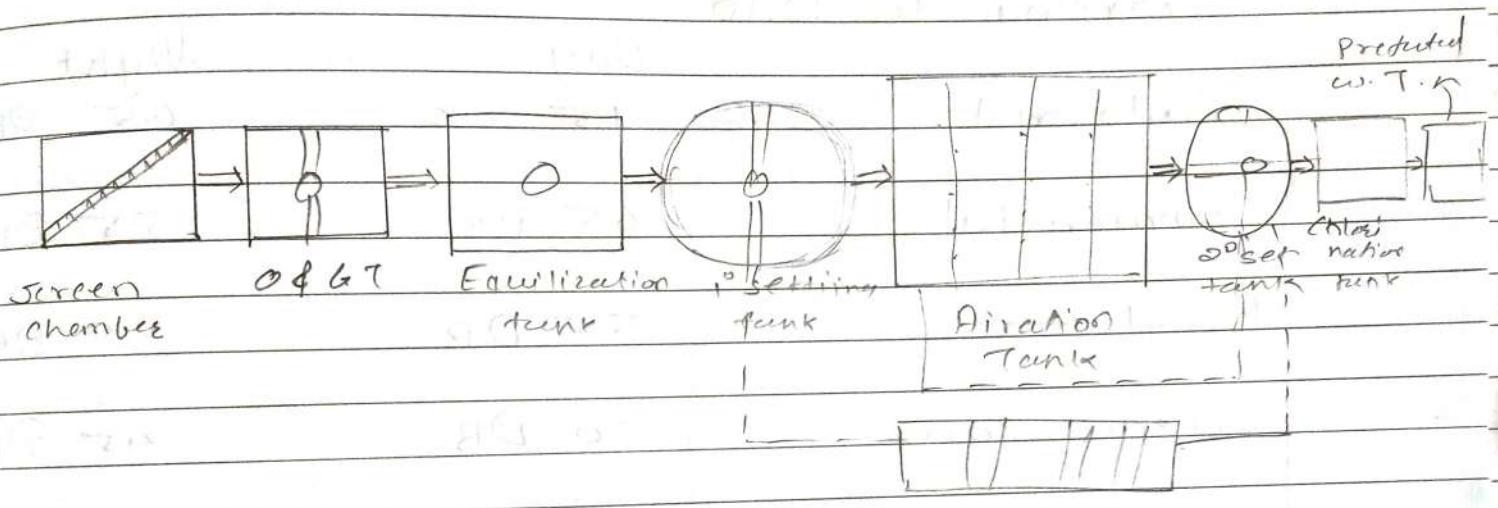
- Low initial cost
- Better collection efficiency about 75 to 80%.
- Small space is required
- It can remove gases also particulates matters simultaneously.

Disadvantages:-

- High power consumption
- Water pollution
- Waste water is generated.

Chp-5

Water pollution.



ETP - Effluent treatment plant

ASP - Activated sludge process

sludge Dewatering

60%

* Noise pollution

According to WHO.

	Day	Night
① Industrial	75 DB	65 DB
Commercial	65 DB	55 DB
Residential	55 DB	50 DB
Silence zone	50 DB	45 DB

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* Water pollution :-

- The negative changes in physical, chemical and biological properties of natural water bodies due to addition of harmful pollutants which adversely affects on living and non-living things in the environment is called water pollution.

* Sources and causes of water pollution.

- Domestic waste water :-

The waste water comes from kitchen, bathroom, toilets, hotels, is called domestic or sewage waste water.

- Industrial waste water :-

The waste water generated from various manufacturing processes of various industries is called effluent. This is very highly concentrated waste water having high BOD and COD.

- Oil leakage

Oil leakage into sea can cause serious problem to aquatic life. Its effects depends on oil concentration and its toxicity.

- Marine dump

Garbage from household and industries contains paper, glass, aluminium, plastic materials etc. This garbage is dumped into the sea, due to this sea water get polluted and adversely affects on aquatic life.

- Chemical fertilizers and Pesticides

Farmers are using chemical fertilizers and pesticides to increase the productivity from crops but when these are getting in contact with ground water and surface water it causes water pollution.

- Thermal pollution | Thermal power plant.

Power plant need water for various uses. Due to this water temp. increases. This water having high temp. which is thrown directly into the sea or river. It reduces oxygen level of water which adversely affects on aquatic life of the in the water.

* Characteristics of waste water.

- ① pH
- ② Solids - total dissolved solid, suspended solid, colloidal solids.
- ③ DO - Dissolve oxygen
- ④ BOD - Biochemical oxygen demand
- ⑤ COD - Chemical oxygen demand.

① Dissolved oxygen:

It indicates the oxygen dissolved in the water. It is important for water living animal or aquatic life. It indicates the biological changes done by ~~aer~~ aerobic & anaerobic micro-organisms in the water. minimum level of DO in water should be 4 mg/litre.

② BOD:-

- Bod means oxygen required for biological of organic matter present in the water. or waste water is called as biological oxygen demand.
- It gives the amount of organic matter present in the water
- For sugar industry influent BOD range is 1000 to 1500 mg/litre for distillery it is 40,000 to 60,000 per daily 800 to 1200; for textile 300 to 400 mg/litre.

③ COD:-

chemical oxygen demand.

Oxygen required for chemical decomposition of organic and inorganic materials present in the water and waste water using oxydising agent $K_2Cr_2O_7$ or $KMnO_4$ is called chemical oxygen demand. effects of water pollution.

* Effects of water pollution

① Effects on human

humans are affected by diseases like Cholera, Jaundis by drinking of polluted water.

- Higher level of Fluoride in water can cause weakening of bones.
- Higher level of arsenic in water can cause a skin cancer.
- Humans are affected by diseases like kidney stones by drinking of hard water.

② Effects on animals:-

- Fishes or animals, plants or aquatic animals are get poison due to water pollution.
- Due to less oxygen in water aquatic animals are get suffocated.
- Reproduction rate of aquatic animals get reduced due to water pollution.

③ Effects on eco-system:-

- Polluted ground water.
- Affects the reproductive system.
- Increase in water pollution leads to increase the growth of algae on surface of water body. which reduces the dissolve of oxygen level in the water.

* Control measures of water pollution:-

- Waste from factories, industries and buildings should be dispose properly.

- Toxic chemicals spray should be replaced by eco-friendly chemical.
- Do not throw waste and oil in water bodies.
- Use proper and effective fertilizers and pesticides.
- Industries must install influent treatment plant & waste water treatment plant.
- Avoid development activities near to the poster line.
- Government should take care of river, Fleming activities seriously.

* Noise pollution:-

The unwanted sound which clumped in the environment and which adversely affects on living and non-living things present in the environment. is called noise pollution.

* Sources of noise pollution:-

① Transportation system :-

- Heavy automobile traffic.
- Heavy vehicles, train, tractors, aeroplanes, vehicles forms are included in transportation system.
- Transportation system noise depends on traffic flow gradient of road, Road surface nature.

- Vehicles time exhaust systems horns gear box & brakes.

② Construction of building and highway:-

- Bulldozers used for demolitions of old side machines used for polishing marbles and tiles, rock, drill machines, air compressor breakers, loader & etc.

③ Industrial sources:-

In that boiler - noise from boiler, machine blower, generator hang, air compressors & pumps.

④ Domestic sources:-

- Radio, T.V., tape recorder, mixer, cooker, washing machines, air conditioners, refrigerators.

* Effects of noise pollution:-

① Effects on human beings.

- Difficulty in breathing, increase in blood pressure, Asthma, difficulty in concentration, depression, sleep disturbance.
- Decrease in work efficiency & irritation occur due to noise pollution.

② Effects on non-living things.

- cracks occur often on materials like glasses, doors and windows and also sometimes of walls of buildings.

* Control measures of noise pollution:

- Workers should have ear plug & ear muffs for protecting hearing protection
- Trees are planted around the industries about 33% of area should be planted or developed by green belt.
- Maintenance of vehicles should be done regularly.
- Lubrication of masonry and surveying should be done in the industry for minimum noise generation.
- Factories should be placed away from the residential area.
- machines & equipment to be well designed relevant to insulation & maintain proper alignment. of machines moving parts should be done exhaust & ventilator should be properly arranged.
- Social awareness school programmes are need to be arranged for educating public about causes & effects of noise pollution by using whats app, facebook, twitter, & tv, and news papers.

* Solid waste -

The material which arises from various human activities & which is normally discarded as useless or unwanted it is called solid waste.

Solid waste contain papers, cardboards, plastic, Rubber, glass, leather, construction waste, food waste and Ash.

Sources of solid waste -

1] Residential -

2] Institutional - school, hospitals & municipal office

3] Commercial - Retail store, service station, ware house.

4] Industrial - Consumer goods, agricultural goods

5] Agricultural - Farmer operations,

6] Municipal - Construction waste, street sweeping, water & sewage treatment solids

Solid waste management

If includes handling, transportation, storage, treatment and disposal of waste generated from residential, commercial and industrial waste.

- To keep the environment clean and healthy the solid waste should be removed as early as possible.

- The frequency of collection mainly depends on quantity of waste generated, size of storage

- facility, season, and hunts available.
- To collect solid waste properly following points should be kept in mind. -
- Collection routes must be as short as possible
 - The training of workers and maintenance of equipment is necessary for proper and safe collection of the solid waste
 - The collection must be daily in commercial area and twice a week in residential area.
 - Awareness programs must be organise for local people.

Factor affecting on solid waste management:-

- Location of dustbins.
- Collection frequency.
- Population density.
- No. of workers used per dumper.
- Time of collection.
- Collection routes
- Cost of collection.

Disposal methods of solid waste.

- 1) Sanitary landfill method
- 2) Composting
- 3) Incineration
- 4) Dumping into sea.

① Landfill method -

- In this method solid waste and soil are placed in alternate layer.
- Decomposition of waste take place and it is converted into stable form.

Advantages -

- Method is simple
- Economical
- Labour cost is less.

Disadvantages -

- Production of leachate in landfills causing surface and ground water pollution
- Aesthetically unattractive site and production of various gases causes air pollution.
- Insects and fly breeding problems.

② Composting :-

- In this method the decomposition of organic materials in the solid waste is take place under the action of micro-organism.
- This compost is used as a fertiliser.

Advantages -

- The no. of industrial waste can be treated by these method.
- This is simple method and economical.

Disadvantages -

- Maintenance cost is high.
- Require labour quantity high.
- It is time consuming.

Incineration -

- In this method combustible material is separated from the solid waste.
- It is then burn in incinerator.
- It consist of furnace provided with chimney.

Advantages -

- Require less area.
- Process is effective.
- less transportation cost.
- It located within city limits.

Disadvantages -

- high initial cost.
- high operation and maintenance cost.
- skilled labour is required.
- Major source of air pollution.

* Biomedical waste

It is defined as wastage generated during the diagnosis, treatment of human beings and animals in research activities and testing of biological wastes.

- Biomedical waste are classified into following categories.

- 1] Human waste - Tissues, organ, body parts
- 2] Animal waste - Animals used in the research there organ, body parts and tissues.
- 3] Micro-biological and biotechnological waste.
e.g - waste from lab culture, micro-organism specimen, human and animals cell culture,
- 4] Waste sharps - Needles, bleeds, glass and syringes.
- 5] Discarded medicines and drugs - liquid wastes, - waste generated from washing, cleaning, house keeping.
- 6] Solid waste - Tubes, rotten dressing, plasters and plastic bottles.
- 7] Incineration ash - Ash generated from incineration from biomedical waste.
- 8] Chemical waste - chemicals used in disinfections.

Sources of biomedical waste:

- 1) Nursing homes -
- 2) Clinics
- 3) Hospitals
- 4) Medical laboratory
- 5) Blood bank
- 6) Medical research & training centre

7) Animal house

8) Blood donation camps.

Treatments on biomedical waste.

- Incineration.

- Autoclaving.

- Disinfection by chemical waste.

- Disposal in municipal land fill.

- Chemical discharge into drain.

* Biomedical waste management

- Waste minimisation :- Hospitals should try to maintain the records of each waste.

They can recycle certain waste items.

- waste segregation - segregation of waste should be done at source. This segregation done in colour coded plastic bags and containers.

Waste category	Type of container	Colour code.
1, 2, 3 & 6	Plastic bags	Yellow
3, 6 & 7	Plastic bags / disinfected container	Red
4, 7	Plastic bags / disinfected container	Blue/white
5, 9, 10	Plastic bags /	Black.

waste treatment on site

- Microbiological, Biotechnological waste, are highly infected, so they should be treated on site with the help of autoclaving and chemical treatment.
- Waste transportation- Waste should be transfer in covered containers, in vehicles

Waste treatment of site

- Microwave.
- Autoclave.
- Hydroclave.
- Incineration.
- Final disposal.

Final disposal treatment include land fill
fermentation, & incineration.

Advantages of B.W management

- Cleaner and healthy surrounding.
- Reduction in infections.
- Reduction in disease spreading.
- Reduction in cost of medical
- Less impact on environment and ecological system
- Increase quality of life.

Soil pollution:-

Soil pollution is a contamination of soil due to human activities and natural activities which can causes harmful effects on living and non-living things.

Sources of soil pollution

- Urban waste - It consist of commercial and domestic waste. e.g. sewage material, garbage materials like plastic, paper, glass, fibre, vegetables & metals etc.
- Industrial waste - These are mainly discharge from the industry from sugar, paper, textile mills and coal industries.
- Agricultural activities - Due to use of excessive fertilizer, pesticides, causes change in soil properties.
- Radioactive components - Radioactive components resulting from radioactive waste from laboratory and industries changes soil prop. and composition.
- High traffic area - Near roadway area having frequent trafficking affects the amount of certain chemicals in the soil.

Effects of soil pollution -

- It reduce the soil productivity.
- Causes soil erosion.
- Causes deforestation.
- It lowers down pH level of soil.
- It affects the plant growth and human life.

Control measures -

- Proper dumping of waste material.
- Good hygienic condition.
- People should be educated for taking care of hygienic conditions.

* Soil erosion control

Soil erosion can be controlled by taking following measures -

- Trees to be plant on hill slope.
- Strip cropping and counter cultivation method should be used.
- Avoid mining of forest area.
- Avoid large use of pesticides and fertilizers.
- Reduce deforestation.

Recycle and reuse of waste

- Waste like plastic, paper, metals should need to be recycle & reuse to lower the soil pollution.

~~ban on toxic elements~~ - Ban should be placed on toxic chemicals, fertilizers & pesticide to avoid soil pollution.

Public awareness -

Government and N.G.O's should spread awareness programme to avoid soil pollution by media like F.B.I.A. newspaper, radio and twitter.