Important suggestions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skills)
4) While assessing figures, examiner may give credit for principle components indicated in a figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case some questions credit may be given by judgment on part of examiner of relevant answer based on candidate understands.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q.1	**Attempt any FIVE of the following**	**10 Marks**
a)	**Define fission and fusion related to nuclear fuel.**	
Ans:	**1.** By breaking up heavy nuclei into nuclei of intermediate size, **the process being known as fission.** **(1 Mark)** **OR** The process in which heat energy is released without using oxygen for combustion in process **is known as nuclear Fission.** **2.** By combining light nuclei, **the process being known as fusion.** **(1 Mark)** **OR** Fusion is the fussing of two or more small atoms into a larger one to, produces heat energy.	
b)	**Classify hydropower plant on the basis of water head and state turbine used for them.**	
Ans:	**Classification the hydro-electric plants According to availability of Head of Water:** **(1 Mark)** 1. Very high head power plant 2. High head power plant 3. Medium head power plant 4. Low head power plant	

	Following types of turbine used in hydro power plant: **(1 Mark)** 1. Pelton wheel for Very high head power plant and High head power plant (300 mtr. And above) 2. Francis Turbine for high head power plant and medium head power plant (Up to 300 mtr.) 3. Kaplan Turbine for Low head power plant (below 40-15 mtr.) 4. Propeller Turbine for Low head power plant (below 15 mtr.)
c)	**State any two advantages of Kaplan turbine over Francis turbine.**
Ans:	**Advantages of Kaplan turbine over Francis turbine:-** **(Any Two advantages expected: 1 Mark each, Total: 2 Marks)** 1. Runner vanes are adjustable 2. Very low head of water is required 3. It has very small number of blades 3 to 8 4. Very less resistances have to be over come 5. Position of shaft is only in vertical direction so space required is less 6. In this turbine the speed of the rotor is much greater than the speed of the water, almost double.
d)	**List different types of concentrating type solar collectors.**
Ans:	**Following types of concentrating type solar collectors:** **(Any TWO Point expected : 1 Mark each point, Total 2 Marks)** 1. Non- concentrating Type:- a) Flat plate collectors (FPC) b)Evacuated Tubular collector (ETC) 2. Concentrating type collectors (focusing type collector): a) Line Focusing: - Linear cylindrical Parabolic (troughs) concentrating collector (CC) b) Point Focusing: - • Central receiver Spherical (Dish) Parabolic concentrating Collector (CC) • Central receiver solar tower with number of distributed Concentrating collector

e)	**State the various types of Biomass Resources.**
Ans:	**Following are the various types of Biomass Resources:-** **(Any Four types expected: 1/2 mark each, Total: 2 Marks)** 1. Bagasse 2. Agriculture residual 3. Forestry residual 4. Energy trees/ crop plantation 5. Dead trees and tree branches 6. Wood processing industrial waste 7. Food processing industrial waste 8. Residential, commercial and industrial waste 9. Peel 10. Coconut shell , ground nut shell 11. Vegetables waste 12. Animal waste 13. Sanitary waste 14. molasses waste 15. Fishery waste 16. Sewage 17. Manure etc.
f)	**State range of wind speed is considered favorable for wind power generation.**
Ans:	**Range of wind speed is considered favorable for wind power generation is:-** **(2 Marks)** ➢ **14.4 to 16.2 Km/hour**
g)	**Define the term "cold reserve" and "hot reserve".**
Ans:	**i) Cold reserves:** **(1 Mark)** It is stand by generating capacity which is available for service but not in operation. **ii) Hot reserve:** **(1 Mark)** It is reserve generating capacity, in operation but not in service (not connected to busbar/grid)

Q. 2	Attempt any THREE of the following	12 Marks
a)	Describe Nuclear Hazards and various ways of disposal of nuclear waste.	

Ans:

➢ **Nuclear hazards**: **(2 Marks)**

The waste produced in nuclear power plant is in the form of solid, liquid & gases, these are radioactive. **These are very harmful to human being, animals, environment and nature, if it is not carefully disposed off.**

➢ **Various ways of disposal of nuclear waste:-**

(Any TWO Point expected : 1 Mark each point, Total 2 Marks)

➢ Solid Waste Disposal:-

- Solid wastes removed from the reactor are very hot and radioactive.
- Solid waste is filled in a sealed container.
- And is kept under water for 5 to 10 years under supervision to reduce its temperature.
- The solid waste container is buried deeply in the ground by making tunnel, however the area must be unused land, away from populated area and there is less rain fall in that area.

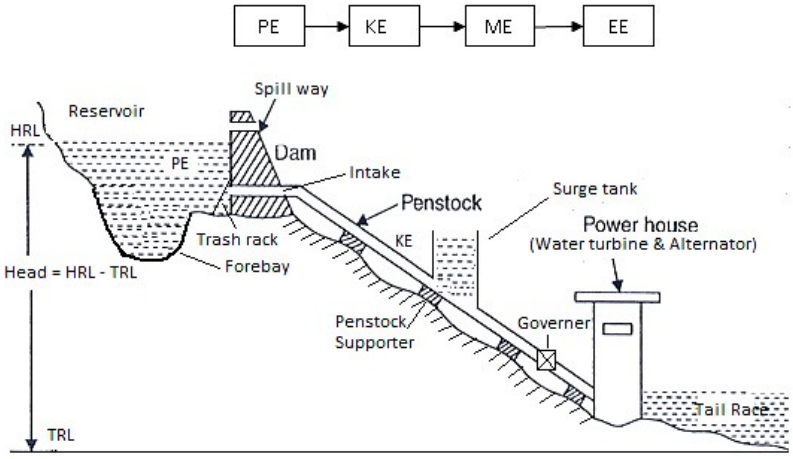
➢ Liquid Waste Disposal:-

- The liquid waste is diluted to a sufficient level by adding large quantity of water.
- The liquid waste after analysis (concentration of radioactive material are measured.) is sealed in a container.
- Then it is disposal off into the sea, several kilometers away from sea shore.

➢ Gaseous Waste Disposal:-

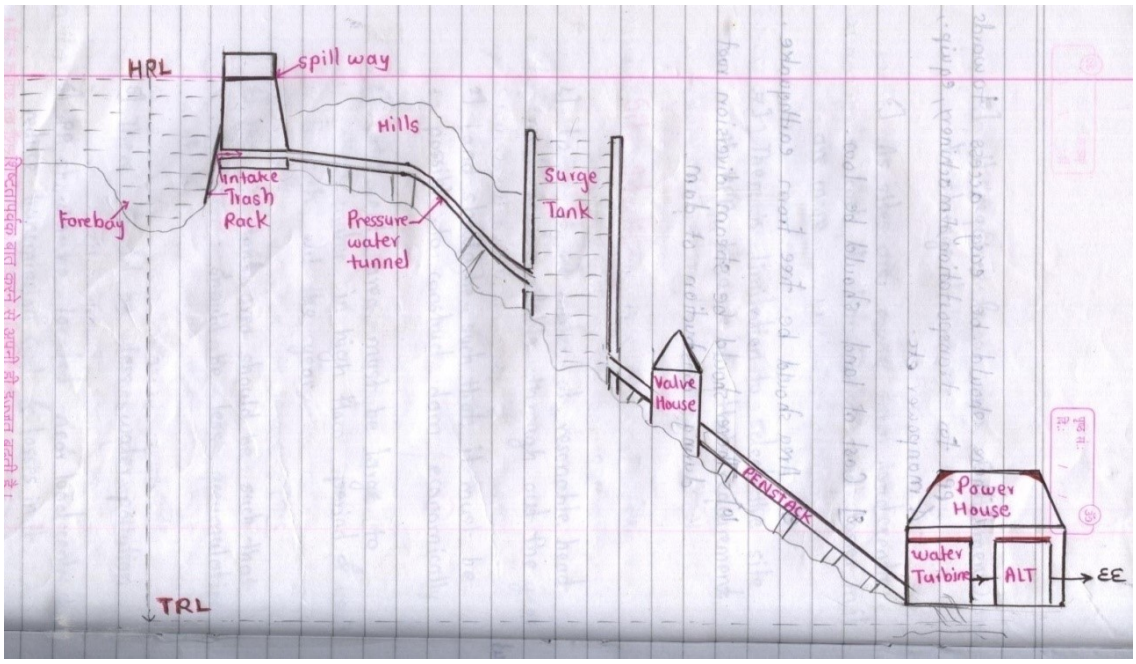
- Gaseous wastes are generally diluted with adding air.
- And passed through high efficiency filter.
- Then passed through radiation monitoring system.
- In this system concentration of radioactive material are measured.
- If it is safe then released to atmosphere at high level through large height chimney.

b)	**Draw schematic arrangement of hydroelectric power station and describe energy conversion process of hydro power plant.**
Ans:	**Schematic arrangement of hydroelectric power station:-** **(Schematic arrangement : 2 Marks & Energy conversion process: 2 Marks)**



or equivalent arrangement

OR



Energy conversion process of hydro power plant:-

Water stored at high level by constructing dam across river. This stored water has potential energy. This stored water is passed to run the water turbine which is

	located at lower level through penstock. Thus potential energy of water is converted into kinetic energy in penstock and turbine converts kinetic energy into mechanical energy and Alternator is coupled to water turbine which converts mechanical energy into electrical energy.
c)	**Describe main features of various types of generators and their suitability w.r.t wind power generation.**
Ans:	**Main features of various types of generators for wind power generation :-** **(Any TWO Point expected : 1 Mark each point, Total 2 Marks)** 1. Generator should be robust in construction 2. It should have less maintenance and long life 3. It should have high efficiency 4. Generator may be AC or DC. 5. Generator may be constant speed or variable speed. 6. Gearbox used may be single stage or multistage. 7. Some generators are direct driven (No gear box) 8. Synchronous generators are using permanent magnets (PM) did not require external DC excitation 9. Synchronous generators required external DC excitation if PM are not used 10. Induction Generators requires reactive power for excitation. In case of standalone loads, a capacitor bank is used to provide the magnetising current and hence establish the magnetizing flux. If it is connected to the electrical grid, then the magnetizing current is taken from the grid. 11. For variable voltage and variable frequency output of generators AC-DC-AC power converters are used to obtain constant voltage and constant frequency supply. 12. The power output of generator (690V as a rated voltage value) fed to a transformer, which converts to the typically 33 kV. **Suitability w.r.t wind power generation:-**

	(Any TWO Point expected : 1 Mark each point, Total 2 Marks) 1. Salient poles are more used in low-speed machines and therefore may be the most useful version for application to direct-drive wind turbines. 2. In small wind turbines SCIG are used and 3. For large wind turbine doubly fed induction generators are used **4.** For small capacity PMSG are used **5.** Now a days large capacity wind turbine uses multi pole permanent magnets (PM) direct driven (No gear box) synchronous generators **6.** Variable speed Generator is preferred over constant speed generator.
d)	**State the causes and impacts of state grid system fault.**
Ans:	**(Causes 2 Marks and Impacts 2 Marks)** **Following are the causes state grid system fault:** **(Any TWO Point expected : 1 Mark each point, Total 2 Marks)** 1. Major imbalance between generation and consumption i.e. demand is more than generation. 2. Low frequency, due to some faults the frequency mismatches i.e. (49.5 to 50.3 Hz). If the frequency is falls or above the permissible limit then, there is possibility of failure of power grid. If fault is not clear in permissible time. 3. Due to breaking of conductor or due to short circuit between two conductors fault occurs which leads to failure of grid. If we cannot clear this fault in less than 1000 millisecond. 4. Power surges causes rapid overheating tends to lead failure of grid. 5. Minor fault in high voltage equipment's if not attended over a period of time results in a total breakdown of equipment suddenly causing grid failure. 6. Illegal utilization of electricity (theft of energy) is also a major reason for power grid failure. 7. Ageing of power equipment's have higher failure rates increases the risk of frequent breakdown.

8. Due to failure of grid connected one of the generator units suddenly.

   Then load is shifted to other generator causes cascade tripping due to over loading.

9. Due to ineffective power delivery planning, co-ordination, supervision and control over generation system causes failure of grid (Due to ineffective work of LDC).

Impact of state grid system fault:

(Any TWO Point expected : 1 Mark each point, Total 2 Marks)

1. All industries are badly affected due to failure of supply and causes huge losses.
2. All health care centers (Major hospitals) are badly affected due to failure of supply and causes disturbance in treatment on emergency patients.
3. Drinking water supply system are badly affected due to failure of supply and causes insufficient/no water supply.
4. All electrical long route trains, local trains, tramways, metro and railway signal system are badly affected due to failure of supply and causes inconvenience.
5. All communication system is badly affected due to failure of supply and causes inconvenience to people.
6. Disturb the routine work of common all people.

Q.3 Attempt any THREE of the following 12 Marks

a) Compare fire tube and water tube boilers used in thermal power plants.

Ans:

(Any Four Point expected : 1 Mark each point Total 4 Marks)

Sr.No.	Fire tube Boilers	Water tube Boilers
1	In fire tube boilers hot gases are passed through the tubes and water surrounds these tubes.	In these boilers water is inside the tubes and hot gases are outside the tubes.
2	Steam at low pressure and low temperature is generated.	Steam at high pressure and high temperature is generated.
3	Rate of steam generation per hour is less.	Rate of steam generation per hour is more.
4	Steaming time is very more.	Steaming time is very less.

5	The output of the boiler is not high.	The output of the boiler is high.
6	Low efficiency.	High efficiency.
7	Less control on temperature of steam.	Better control on temperature of steam.
8	Not respond quickly to change in steam demand.	Respond quickly to change in steam demand.
9	Its weight is more.	Its weight is less.
10	Less risk of explosion due to low pressure.	Risk of explosion is more due to high pressure.
11	Not suitable for large capacity thermal power plant.	Suitable for large capacity thermal power plant.

b) Describe safe practices for hydro power plants.

Ans: **Following are the safe practices:-**

(Any four point expected: 1 Mark each, Total : 4 Marks)

1. The Personal Protective Equipment (PPE) / protective devices made available for individual or collective use of the workers likely to be affected by the hazards of the workplace or process.
2. Not to allow any worker to work in an unsafe condition, nor with unsafe equipment
3. Sufficient number of Supervisors shall be appointed for adequate and constant supervision at all times and in all workplaces
4. All workers are protected from the hazards, arising out of their work or due to the work carried out by others, in the vicinity
5. Safety training shall be provided to all employs Appoint a Safety Officers with the qualifications and experience
6. Safety posters, slogan competition, special meetings and talks shall be organized.
7. Emergency action plan should be ready to deal with fire and explosion
8. Power plant should be protected against lightning stroke i.e. use appropriate type of lightning arrestor.
9. Barricades, warning sign, safety posters should be provided to hazards and important locations

10. Station should have at least two independent ways to exit. If one route becomes inaccessible, an alternative emergency escape route should always be available. Adequate lighting is essential for emergency escapes.
11. During flood there should be provision of automatically stop the hydro plant.
12. Plant should be inspected from OSHA and NFPA organization

OR

Following are the different protection provided to HPP for safety:-

1. Fore bay:-

It serves the following function is-

- It store rejected water immediately when load on turbine reduces so it avoid water hammer effect in penstock and protect the penstock.
- It avoids cavity effect in penstock when load on turbine increases (Because it immediately supplies the water).
- It acts as buffer storage of water during flooding which increases the safety of dam.

2. Trash rack (Screen/ Booms):-

- It avoids entry of debris (solid particles, large fish, and ice) going towards the turbine.
- It avoids choke up of penstock and damage to turbine.

3. Spillways: -

- It discharge excess water from reservoir when the water exceeds the storage capacity of reservoir.
- It avoids damage to dam due to excess pressure of water.
- It acts as a safety valve to the dam.

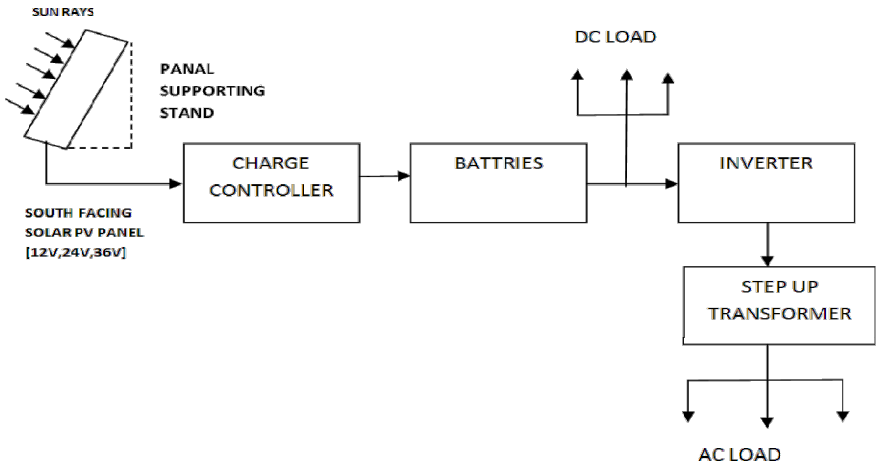
4. **Protection provided to penstock**:

- Surge Tank or fore bay
- Automatic butterfly valve
- Air valve

5. **Surge tank:-** –

- It protects penstock from water hammer effect when load on turbine reduces (Because it immediately stores the rejected water).
- It avoids cavity effect in penstock when load on turbine increases (Because it immediately supplies the water).

c)	Describe with layout the working of solar Photo Voltaic (PV) power plant.
Ans:	**Diagram of solar photovoltaic power plant :** **(Layout : 2 Marks & working : 2 Marks, Total : 4 Marks)**



OR Equivalent Figure

Working:-

1. Photovoltaic cell panel:

Its function is to convert sunrays directly into DC electricity.

2.Battery charge Controller:

It protects battery from over charging and it prevents battery from over discharging. In this way it increases life of storage battery. (OR a charge controller is needed to ensure the battery is neither over nor under-charged)

3.Storage Battery:

Its function is store DC electrical energy generated by P.V. cell which can be used whenever required.

Generally battery having long life are used .There are two types of battery:

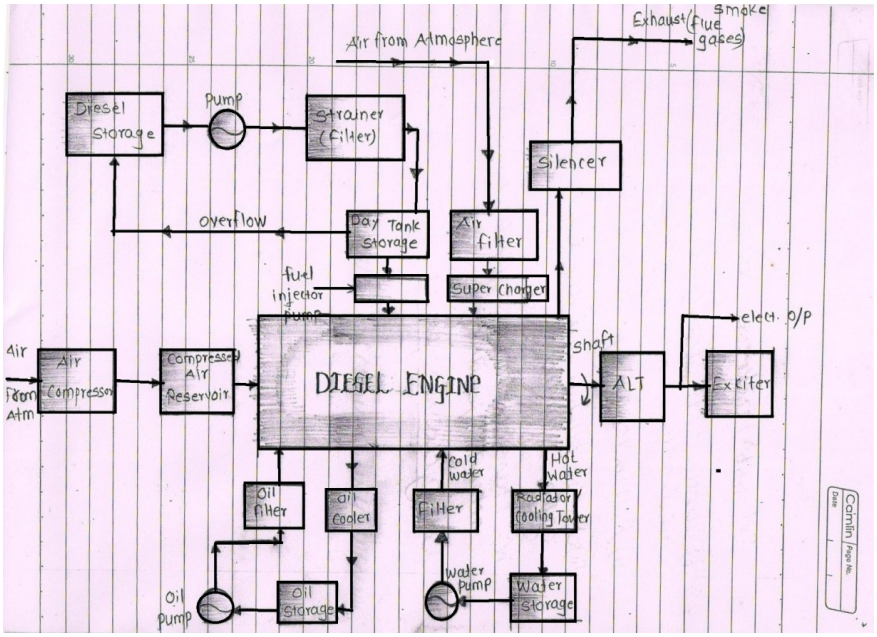
1. Lead acidic battery
2. Nickel cadmium battery

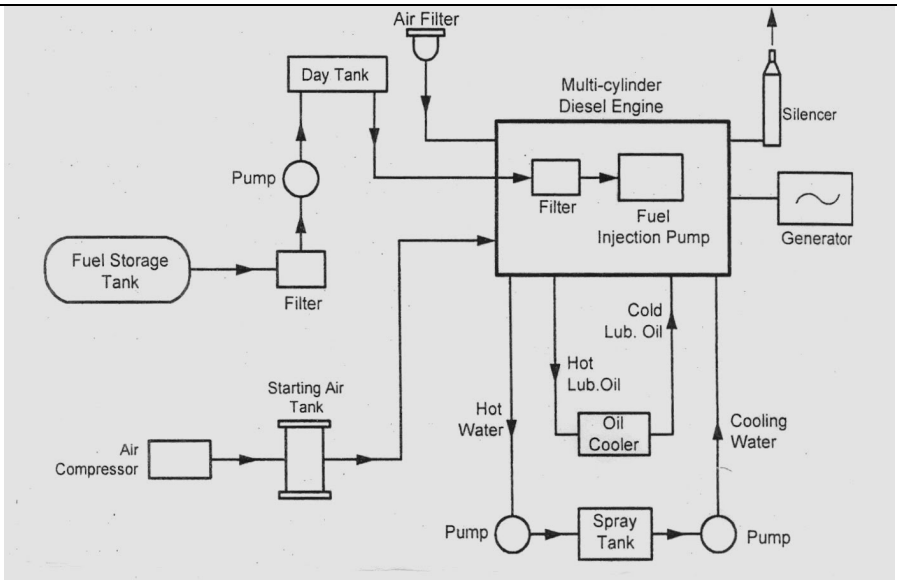
4.Inverter:

It converts DC supply into AC supply.

5. Step-up transformer:

It step-up input voltage to utilization voltage e.g. 230V

d)	**State the various problems caused during operation of large wind power generators.**
Ans:	**Following are the various problems caused during operation of large wind power generators: (Any four point from following or equivalent are expected: 1 Mark each, Total : 4 Marks)** 1. Wind turbine produces noise during operation 2. It kills the large birds and bats some time when the birds collide to the turbine blades 3. Wind turbine structures, can interfere with communication / radar signals when these signals interrupted by the turbine structure or the rotor. 4. Wind turbines can cause problems with television reception 5. Wind turbine produces Shadow flicker can be annoying (disturbing) when the shadow of moving turbine blades fall on a house/ground at certain times of the day and year. 6. Output voltage content harmonics if converters are used 7. The regular blocking and unblocking of the direct sun-light by the rotating turbine blades.
Q.4	**Attempt any THREE of the following 12 Marks**
a)	**Draw schematic arrangement of diesel engine power station and important systems and essential components of diesel plant**
Ans:	**Schematic arrangement of diesel engine power station :** **(Schematic arrangement: 2 Mark & Essential Components: 2 Mark. Total 4 Marks)**  **OR equivalent figure**



Essential components of diesel plant:-

1) Diesel Engine
2) Engine air intake system
3) Engine fuel System
4) Engine exhaust system
5) Engine cooling System
6) Engine Lubricating System
7) Engine starting system
8) Flywheel
9) Governor
10) Alternator

b) Explain layout of thermo-chemical based (Municipal waste) power plant.

Ans: **(Explain 2 Marks and layout 2 Marks)**

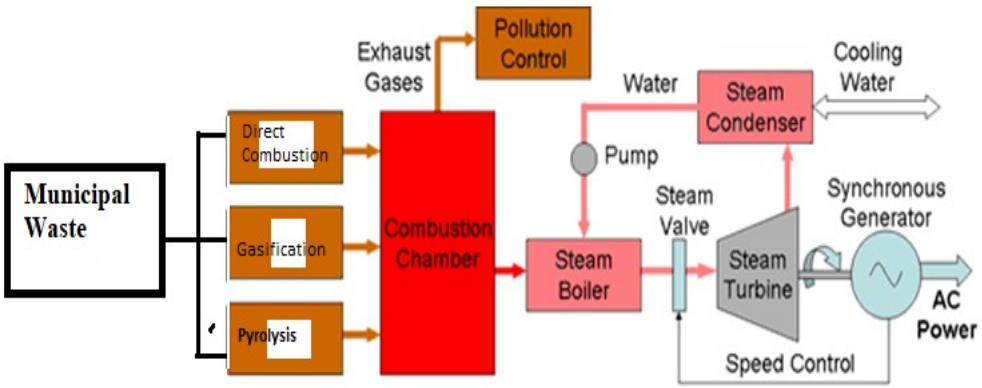
Explanation of Thermo chemical based (municipal waste PP):- **(2 Marks)**

In this process dry municipal waste (biomass fuels) is converted to produce gas, liquid fuels or oil by thermo chemical conversion Thermo-Chemical conversion are of following ways:-

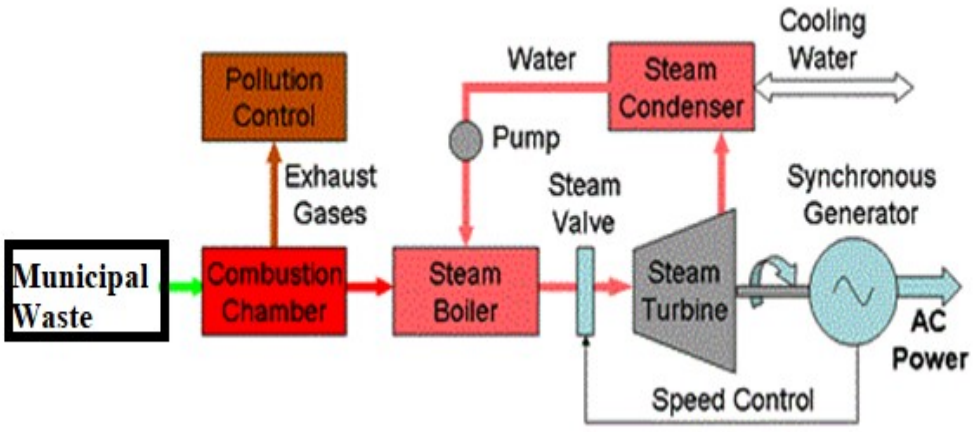
1. Direct combustion
2. Gasification
3. Pyrolysis

Which can be used to produce heat energy. This heat energy is used to produce high pressure and high temperature steam. This steam is used to run the steam turbine. Steam turbine is coupled with generator to produce electrical energy.

Layout of a thermo-chemical based power plant: **(2 Marks)**



OR Equivalent Figure



c) Compare Horizontal axis and vertical axis wind machine on the basis of : (i) Power captured for the same tower height. (ii) Noise problem. (iii) Complexity of design and yaw mechanism (iv) Effect of fatigue arising from numerous resonance in structure.

Ans:

(1 Mark each point Total 4 Marks)

Sr.No.	Points	Horizontal axis Wind Machine	vertical axis wind machine
i)	**Power captured for the same tower height.**	More	Less
ii)	**Noise problem**	Noise in operation	Quite in operation
iii)	**Complexity of design and yaw mechanism**	Complicated in design and Yaw mechanism is required.	Simple in design and Yaw mechanism is not required.
iv)	**Effect of fatigue arising from numerous resonance in structure.**	Less	More

d) Define the terms: (i) Load factor (ii) Diversity factor (iii) Demand factor (iv) Plant capacity factor.

Ans:

(Each definition 1 Mark)

i) Load Factor: - **(1 Mark)**

It is the ratio of average demand /load to maximum demand during given period is known as Load Factor.

OR

$$\text{Load Factor} = \frac{\text{Average Demand (load)}}{\text{Maximum demand (load)}}$$

OR

$$\text{Daily Load Factor} = \frac{Number\ units\ generated\ in\ 1\ Day}{Number\ of\ hours\ in\ a\ day\ (24\ hours) \times MaximumDemand}$$

OR

$$\text{Monthly load Factor} = \frac{Number\ of\ units\ generated\ (KWH)\ in\ month}{Number\ of\ hours\ in\ a\ month\ \times Maximum\ Demand}$$

OR

$$\text{Yearly load Factor} = \frac{\text{Number of units generated (KWH) in one Year}}{\text{Number of hours in one year (8760H)} \times \text{M.D}}$$

ii) Diversity Factor:- **(1 Mark)**

The ratio of the sum of the individual consumers, maximum demand to the maximum demand on power station.

OR

$$\textbf{Diversity Factor} = \frac{\text{Sum of individual consumers max imum demand}}{\text{Maximum demand on power station}}$$

iii) Demand factor: **(1 Mark)**

It is the ratio of maximum demand on the power station to its connected load.

OR

Mathematical expression:

$$\textbf{Demand Factor} = \frac{\text{Maximum Demand}}{\text{Connected load}}$$

iv) Plant capacity factor: **(1 Mark)**

"The net capacity factor of a power plant is the ratio of its actual output over a period of time, to its potential output if it were possible for it to operate at full nameplate capacity indefinitely.

OR

It is the ratio of actual energy produced (generated) to the maximum possible energy that could have been produced (generated) during a given period.

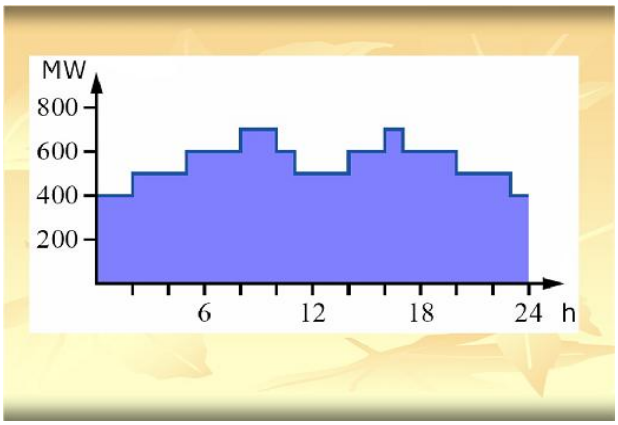
OR

$$\text{Plant Capacity Factor} = \frac{\text{Energy that is produced}}{\text{Maxium energy that can be produced}}$$

$$\text{Plant Capacity Factor} = \frac{\text{Average demand}}{\text{Plant Capacity}}$$

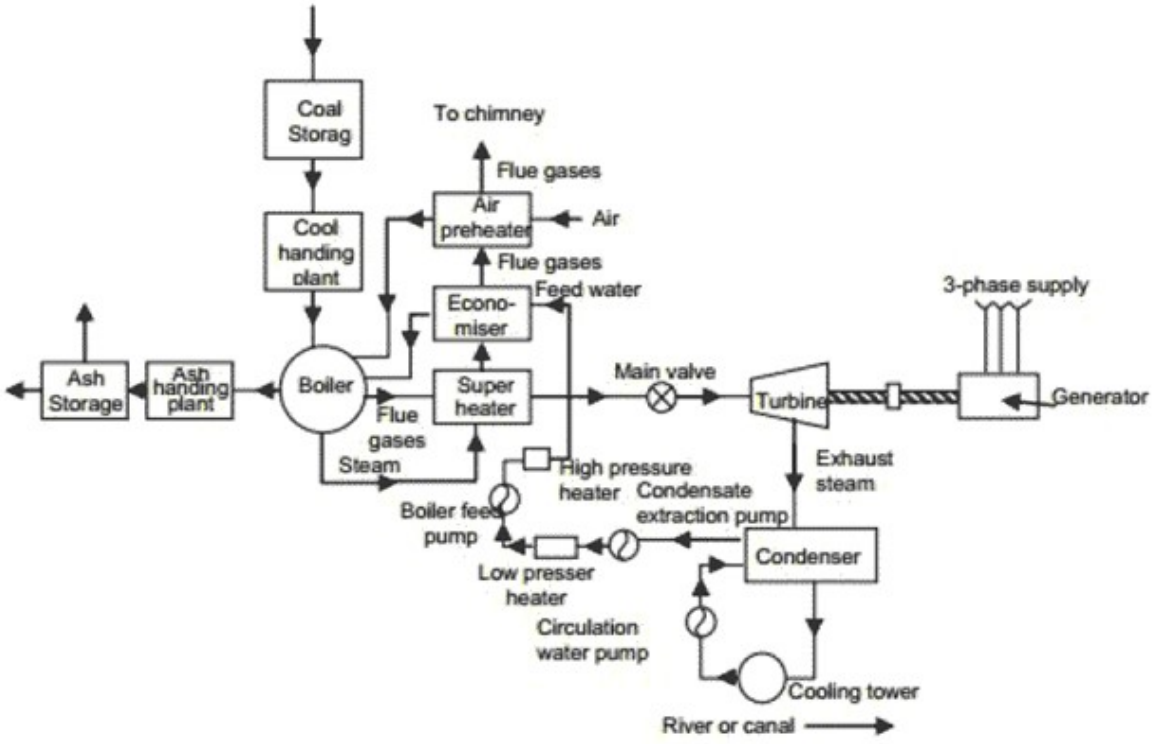
OR

$$\textbf{Plant capacity factor} = = \frac{\text{Actual energy generated}}{\text{Maximum possible energy (KWH) that could have been generated}}$$

e)	**Explain how load curves helps in the selection of size and number of generating units.**
Ans:	 or equivalent figure **Load curves helps in the selection of size and number of generating units as** **Following information is obtain from load curve:-** **(Any Four Point expected : 1 Mark each: Total 4 Marks)** 1. The variation of load on the plant during different hours of a day. 2. Load at any time during a day/month/year can be determined. 3. The area under the curve gives number of units generated daily/month/yearly 4. Maximum demand can be determining which largest peak value on the curve. 5. The maximum and minimum values of load during a day. 6. Average demand can be determine $$\text{Average demand} = \frac{\text{Number of unit generated}}{\text{Number of hours}}$$ 7. Load factor can be determine: $$\text{Load factor} = \frac{\text{Average Demand}}{\text{maximum demand}}$$ 8. The load curve helps in selecting the size and number of generating units. 9. Operation schedule of generating station can be determined. 10. It gives the indication whether the station is working efficiently or not.

Q.5	Attempt any TWO of the following 12 Marks
a)	**Explain with layout the working of typical thermal power plant with steam turbines and electric generators.**

Ans: **layout the working of typical thermal power plant with steam turbines and electric generators:** **(Layout: 3 Marks & Working : 3 Marks, Total 6 Marks)**

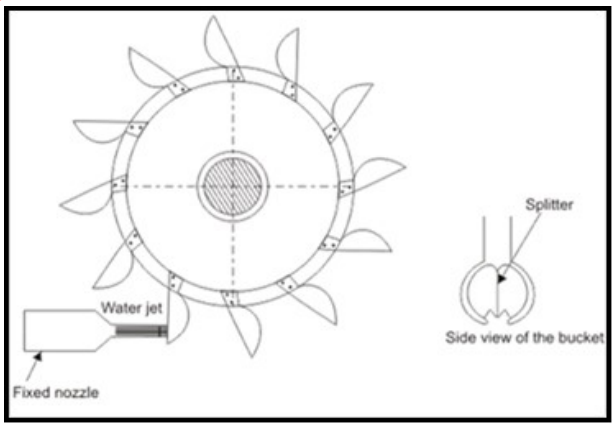


or Equivalent Figure

Working:-

In thermal power plants, the heat energy obtained from combustion of solid fuel (mostly coal) is used to convert water into steam, this steam is at high pressure and temperature. This steam is used to rotate the steam turbine. Shaft of turbine is connected to the generator. The generator converts the mechanical energy of the turbine into electric energy.

b)	**Explain with neat sketch the construction and working of pelton turbine used in hydro power plant.**
Ans:	**Diagram of Pelton Wheel:-** **(Diagram : 2 Marks, Construction : 2 Marks & Working : 2 Marks,Total 6 Marks)**



OR equivalent Sketch

Construction :
The various parts of the Pelton turbine are:

1. Nozzle and Flow Regulating Arrangement (Spear)

Nozzle is used to increase the kinetic energy of the water that is going to strike the buckets or vanes attached to the runner.

The quantity of water that strikes the buckets is controlled the spear. It is a conical needle present in the nozzle automatically in an axial direction.

When the spear is move backward the rate of flow of water increases and when it is pushed forward the rate of flow of water decreases.

2. Runner and Buckets

Runner is a rotating part of the turbine. It is a circular disc on the periphery of which a number of buckets evenly spaced are fixed.

The buckets are made by two hemispherical bowl joined together.

The buckets of the Pelton turbine are made up of cast iron, cast steel bronze or stainless steel.

3. Casing:

The outer covering of the turbine is called casing.

It prevents the splashing of the water. It protects the runner, runner buckets and other internal parts of the turbine from an external damage.It also acts as a safeguard in the case of any accident occurs. Cast iron or fabricated steel plates are used to make the casing of the Pelton Turbine.

4. Breaking jet:

In order to stop the runner in the shortest possible time a small nozzle is provided which directs the jet of water at the back of the vanes. This jet of water used to stop the runner of the turbine is called breaking jet.

Working of Pelton wheel:

The water stored at high head is made to flow through the penstock and reaches the nozzle of the Pelton turbine.

The nozzle increases the K.E. of the water and directs the water in the form of jet.

The jet of water from the nozzle strikes the buckets (vanes) of the runner. This made the runner to rotate at very high speed.

The quantity of water striking the vanes or buckets is controlled by the needle valve present inside the nozzle.

The generator is attached to the shaft of the runner which converts the mechanical energy of the runner into electrical energy.

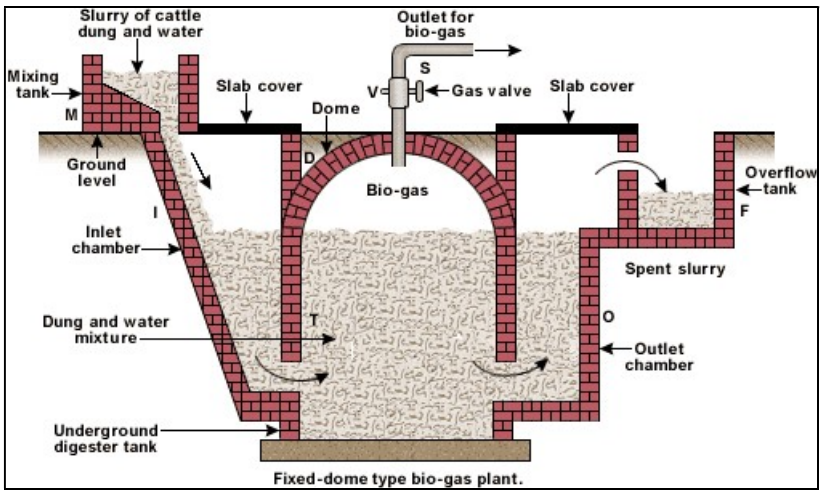
c)	**Explain with neat sketch, layout of Bio-chemical based (biogas) power plant.**
Ans:	**(Explanation : 3 Marks & Sketch Layout : 3 Marks, Total 6 Marks)**

Explanation:- **(3 Marks)**

In this process biomass fuel is converted to produces methane gas by pyrolysis or fermentation processes.

Which can be used to produce heat energy which is used to produce steam at high pressure and temperature. This steam is used to rotate the steam turbine. Shaft of turbine is connected to the generator. The generator converts the mechanical energy of the turbine into electric energy.

Layout of Bio-chemical based (biogas) power plant:- **(3 Marks)**



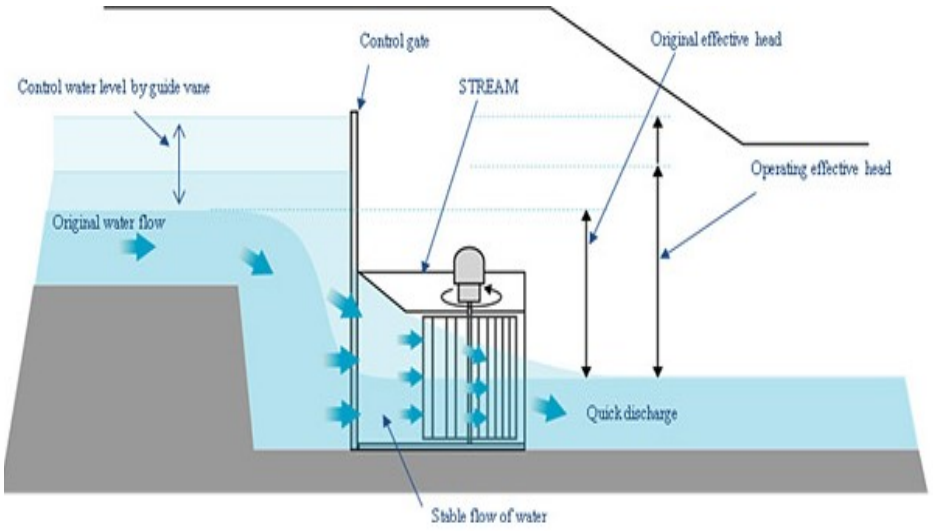
OR equivalent neat sketch layout

Q.6	**Attempt any TWO of the following** **12 Marks**
a)	**Draw the layout of typical micro hydro scheme and describe potential locations of micro-hydro power plants in Maharashtra.**

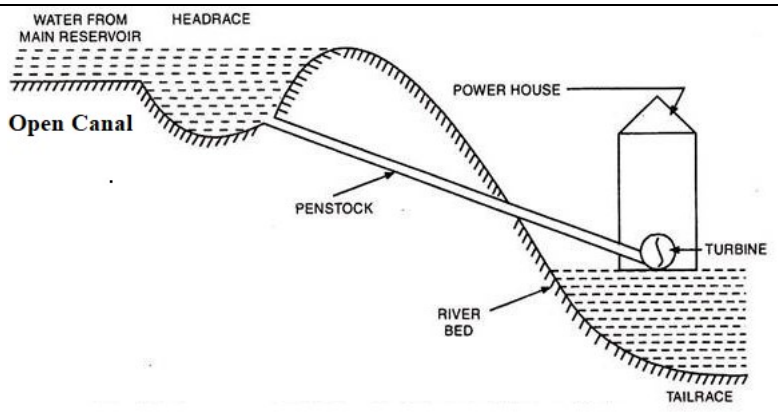
Ans:

Note:- Any equivalent layout should be considered
(Layout: 3 Marks, potential locations: 3 Marks, Total: 6 Marks)

Layout of typical micro hydro scheme: **(3 Marks)**



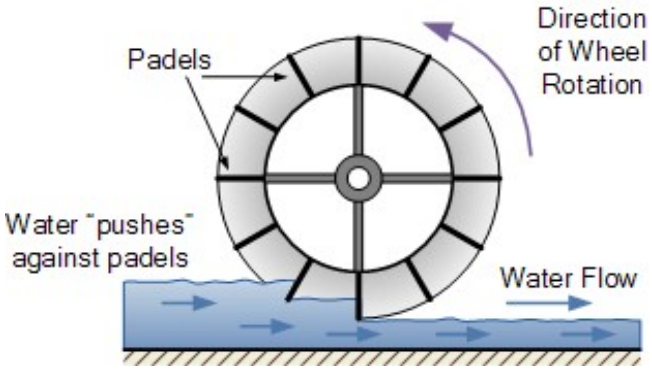
OR



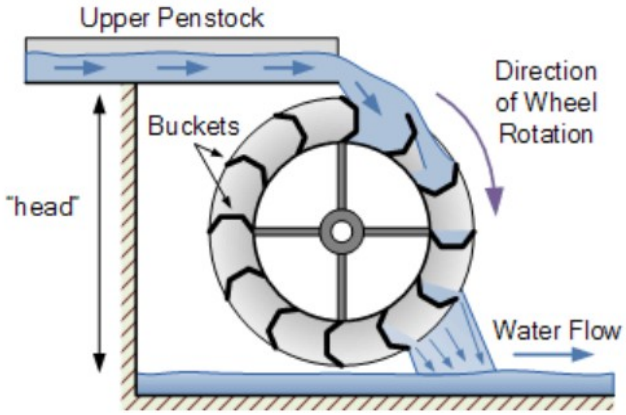
OR

Following types of Water Wheels (Gravity Turbines) are used to obtain mechanical power in case of Run of river scheme these water wheels are connected to generator to obtain electrical out put.

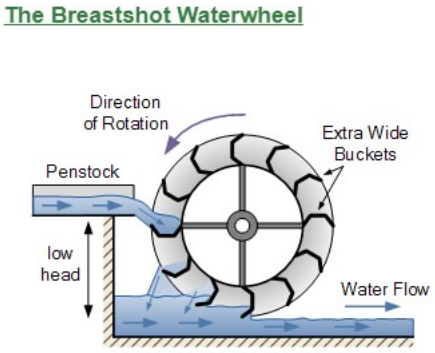
Undershot Water Wheel: -



Overshot Water Wheel: -



Breast shot water wheel:-



Potential locations of micro-hydro power plants in Maharashtra.

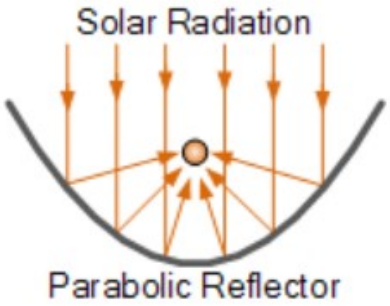
(Any three location are expected 1 Mark each Total 3 Marks)

Note :- Any location other than following are should be consider

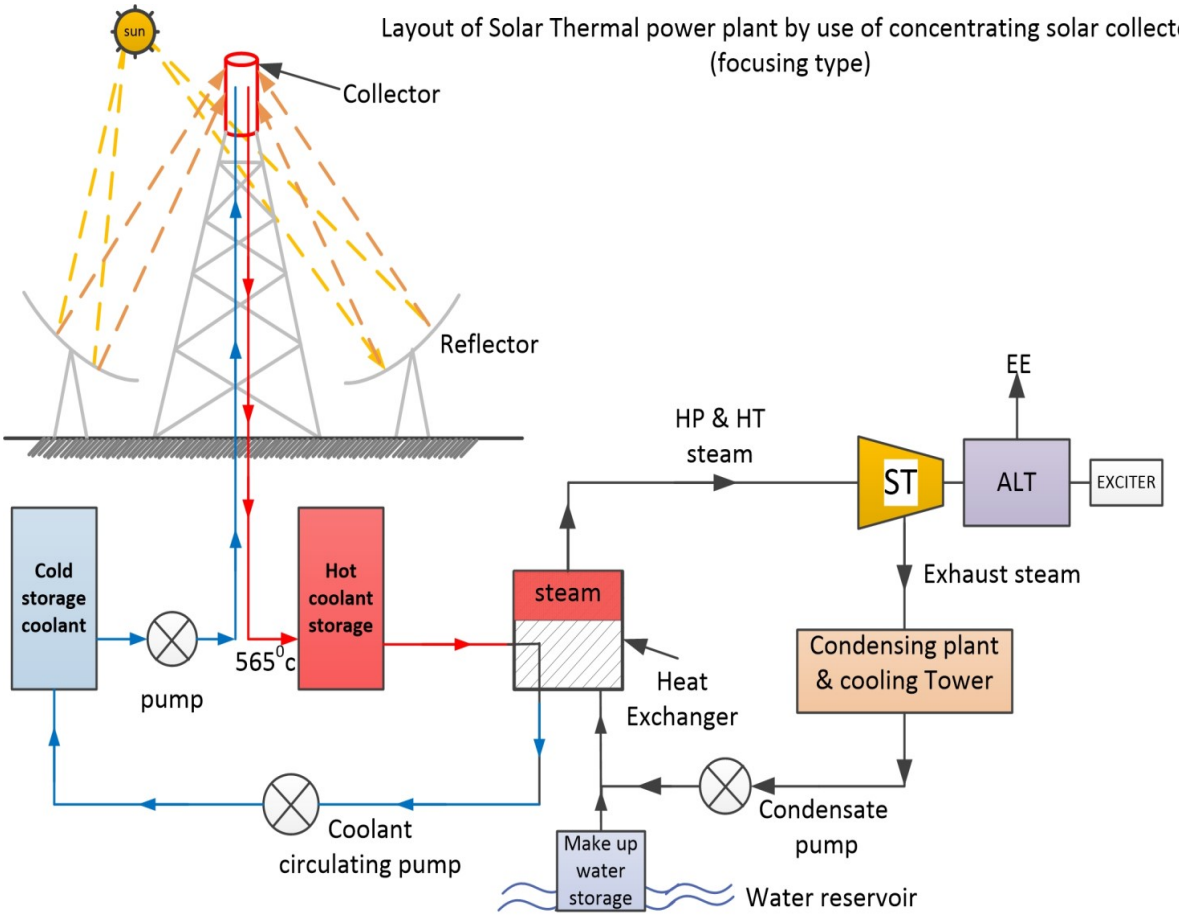
Sr.No.	Location name in Maharashtra
1	Terwanmedhe
2.	Ganagamshet project (Kolhapur)
2	Karwa project Nasik
3	Shenur project Amravati
4	Upper wardha project Amravati
5	Dham Project (Wardha)
6	Mukne Project (Nasik)
7	Khaner project (Satara)
8	Hetwane project (Raigad)
9	Kadwi project (Kolhapur)
10	Wan project (Akola)
11	Sasari project (Kolhapur)
12	Kumbhoi project (Kolhapur)
13	Patgaon project
14	Dom
15	Vaitarna D.T
16	Radhanagri
17	Manikodh
18	Dimbhe
19	Surya

b)	**Explain with layout, the working of parabolic trough collector concentrated solar power plants.**
Ans:	**(Explanation : 3 Marks, Layout : 3 Marks, Total : 6 Marks)**

layout of parabolic trough collector concentrated solar power plants : (3 Marks)



OR



OR equivalent Layout

- It consists of disc 6.6 meter in diameter has been made from mirrors formed in

to the shape parabola called as concentrator.

- Surface absorber (Receiver) which is well insulated which is located at focal point
  - The concentrator captures and reflect solar radiation towards receiver /collector (absorber)
  - The receiver absorbs the concentrated sunlight rays and gets heated.
- The disc can be turn automatically up-down and left-right, so that sun is always kept in a line. Thus the sun can be fully tracked.

OR

Working: **(3 Marks)**

- The concentrator captures and reflect solar radiation towards collector (absorber)
- The receiver absorbs the concentrated sunlight rays and gets heated.
- The secondary fuel (coolant or working fluid) is passed through collector.
- Transferring its heat energy to a working fluid.
- This coolant gets heated to a very high temperature.
- This hot coolant is stored in transport-storage system (a portion of the thermal energy is stored for later use).Thus solar energy can be used even when sun rays are not available
- Then hot coolant is passed through heat exchanger (steam generator) where steam at high temperature and high pressure is generated.
- This secondary fuel (coolant or working fluid) is re-circulated again and again.
- This steam at high temperature and high pressure is used to run the steam turbine.
- Steam turbine is coupled with alternator which converts mechanical power to electrical energy
- Exhaust steam is condensate in condenser.

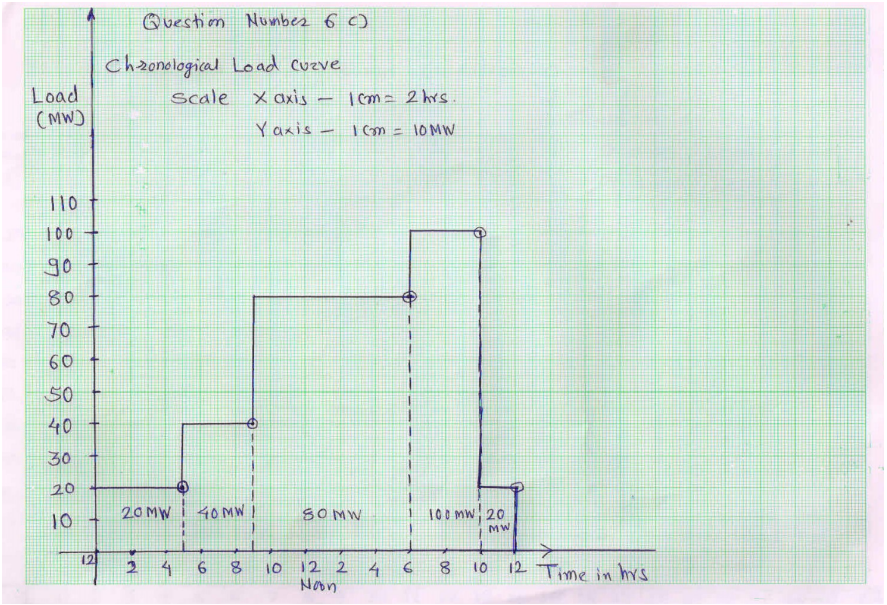
c) **A load on a power plant on a typical day is as under:-**

Time	12-5 AM	5-9 AM	9-6 PM	6-10 PM	10 PM-12 AM
Load in MW	20	40	80	100	20

Plot the chronological load curve and load duration curve. Find the load factor of the plant and energy supplied by the plant in 24 hours.

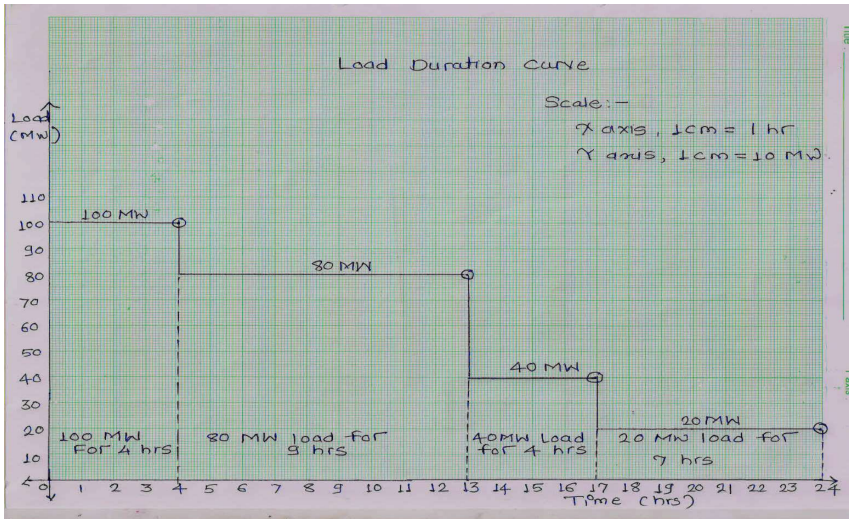
Ans: **Solutions:**

i) Chronological load curve: ---------- **(1 Mark)**



or equivalent graph

ii) load duration curve: ---------- **(1 Mark)**



or equivalent graph

i) It is clear from the load curve that maximum demand on the power station is **100 MW** and occurs during the period 6-10 PM

Maximum Demand: 100 MW ---------- **(1/2 Mark)**

ii) Energy supplied by the plant in 24 hours (Units generated /day) =

$= Area\,(in\ KWh)\ under\ the\ load\ curve$

$= 10^3\ (20\times 5 + 40\times 4 + 80\times 9 + 100\times 4 + 20\times 2)$

$= 10^3\ (100 + 160 + 720 + 400 + 40)\ kWh$

$= 1420\times 10^3\ KWh$ **OR** $= 1420\ MWh$ - ---------- **(1 Mark)**

iii)Average Load = ---------- **(1/2 Mark)**

$$= \frac{Units\ generated\ per\ day}{24\ hours} = \frac{1420\times 10^3}{24} = 59.1666\times 10^3\ KW$$

iv) Load Factor =

$$= \frac{Average\ load}{Maximum\ demand} = \frac{59.1666\times 10^3}{100\times 10^3}$$ ----------**(1Mark)**

= 0.591666 ---------- **(1 Mark)**

OR

$= 59.16\,\%$

----------END----------