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.

.1	**Attempt any FIVE of the following**	**10 Marks**
a)	**List any two Thermal Power Station in Maharashtra with their installed capacity.**	

Ans: **(Any Two power plant name expected or any equivalent: 1 Mark each, Total 2 Mark)**

Sr.No.	Name of Thermal Power Plant	Plant Capacity
1	Koradi	1100 MW
2	Nashik	910 MW
3	Chandrapur	2340 MW
4	Parali	1130 MW
5	Bhusawal	920 MW
6	Paras	500 MW
7	Khaparkheda	1340 MW
8	TATA (Trombay)	1400 MW
9	Dhahanu (Thane)	500 MW
10	Wardha	135 MW
11	Amravati	2700 MW
12	Jindal (Ratnagiri)	1200 MW

b)	**State any two applications of solar energy.**
Ans:	**Solar energy can be used directly or indirectly for following applications or any equivalent:** **(Any Two applications expected: 1 Mark each, Total 2 Marks)** 1. For street lighting. 2. For road Traffic, signaling system. 3. For railway Traffic signaling system. 4. For lifting water with the help of solar pumps. 5. In satellite solar energy is used. 6. In weather monitoring System. 7. Lighting in remote place area.(Off grid) 8. Solar cells are used in watches and calculator. 9. Solar mobile charger. 10. For radio and Television set. 11. Solar blinker and road divider. 12. Solar mini cars are under development. 13. Solar cooker. 14. Solar water heater. 15. Solar dryer for crops. 16. Solar furnace 17. Solar distillation 18. Space heating of building
c)	**List out major wind farms in India.**
Ans:	**Major wind farms in India or any equivalent:** **(Any Two wind farms expected: 1 Mark each, Total 2 Marks)**

S.No	**Major wind farms in India**
1	Dhalgaon Wind farm of Sangli, Maharashtra,

		2	Vankusawade Wind Park in Satara, Maharashtra,
		3	Vaspet Wind farm of Maharashtra,
		4	Brahmanvel Wind Farm Dhule, Maharashtra
		5	Tuppadahalli Wind Farm, Chitradurga , Karnataka
		6	Beluguppa Wind Park in Andhra Pradesh.
		7	Anantapur Wind Park in Andhra Pradesh.
		8	Muppandal Wind farm Kanyakumari, Tamil Nadu
		9	Jaisalmer Wind Park, Rajasthan
		10	Damanjodi Wind Farm, Odisha
d)	**Define State grid and National grid.**		
Ans:	**i) State Grid System:** **(1 Marks)** When all the major generating stations in state are interconnected to each other through transmission line, it forms a state grid system **ii) National Grid System:** **(1 Marks)** All state grids are interconnected to each other through transmission line; it forms a national grid system		
e)	**Name the main parts of solar power plant.**		
Ans:	**Main parts of solar power plant:-** **(2 Marks)** 1. Solar panel (PV cell panel) 2. Charge controller 3. Storage battery 4. Inverter 5. Step up transformer **OR Student may write**		

Main parts of solar power plant. **(2 Marks)**

1. Concentrator
2. Receiver
3. Transport-storage (a portion of the thermal energy is stored for later use)
4. Steam generator (Heat exchanger)
5. Condenser
6. Steam turbine
7. Alternator

f) Classify hydro power plant on the basis of availability of water head.

Ans: **Classification the hydro-electric plants According to availability of Head of Water:**

(2 Mark)

1. Very high head power plant
2. High head power plant
3. Medium head power plant
4. Low head power plant

OR

1. High head power plant
2. Medium head power plant
3. Low head power plant

g) List any two large hydro power plants in Maharashtra with their capacity.

Ans: **Hydro-electric power stations in Maharashtra or equivalent:-**

(Any Two plants expected : 1 Mark each, Total : 2 Marks)

	List of large hydro power plants in Maharashtra	
S.No	**Location**	**Capacity**
1	Koyana	1960MW
2	Ghatghar Dam	250MW
3	Bhira (TATA)	150 MW
4	Mulshi Dam	150MW
	Student may write following location	
5	Bhira Tail Race	80 MW

6	Bhivapuri (TATA)	72 MW
7	Khopoli (TATA)	72 MW
8	Tillari	60 MW
9	Pench project	53 MW
10	Bhandara	34 MW
11	Dudhgaon	24 MW
12	Chadholi(Warana)	16MW
13	Jayakwadi	12 MW
14	Paithon/Ujjani	12 MW
15	Veer	9 MW
16	Bhatghar	16 MW
17	Vaitarana Dam	1.5 MW
18	Eldary	22.5 MW
19	Radhanagri	4.8 MW
20	Paitan	12 MW
21	Pawan	10 MW
22	Panshet	8 MW
23	Varasgoan	8 MW
24	Kanher	4 MW
25	Bhatsa	15 MW
26	Dhom	2 MW
27	Manikdoh	6 MW
28	Yeoteshwar	0.075 MW
29	Dimbhe	5 MW

Q. 2 **Attempt any THREE of the following** **12 Marks**

a) **Describe any four 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

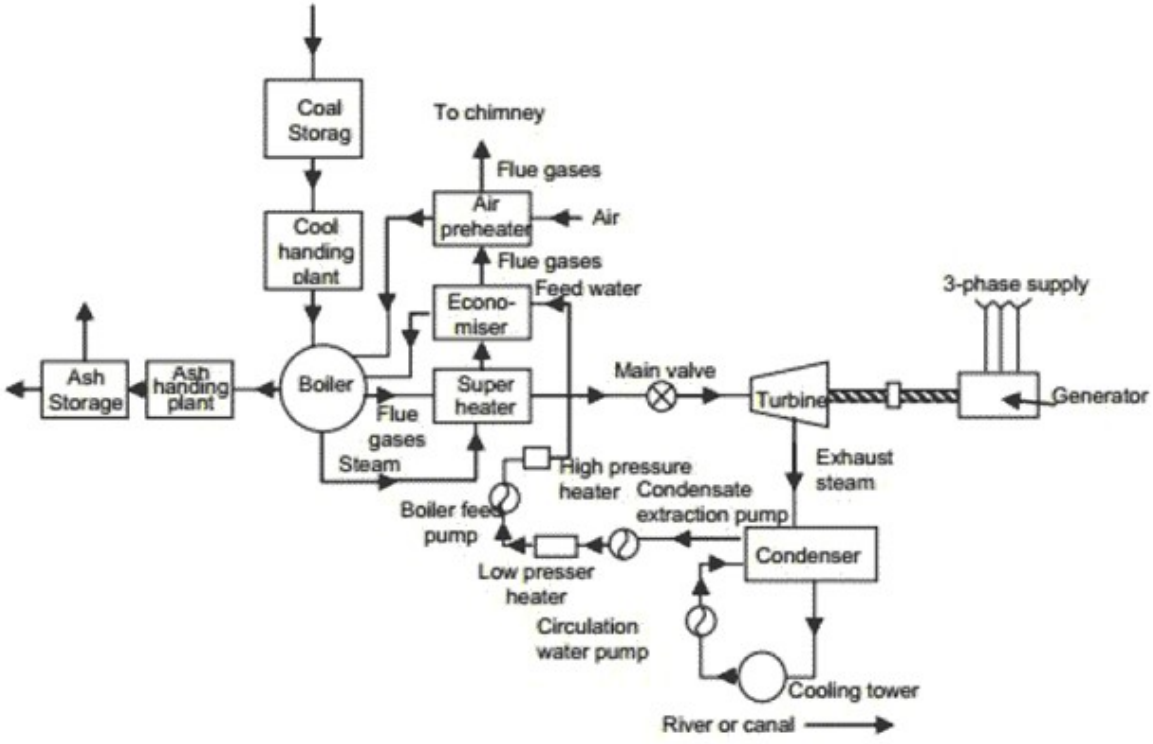
5. **Surge tank:-**

- 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).

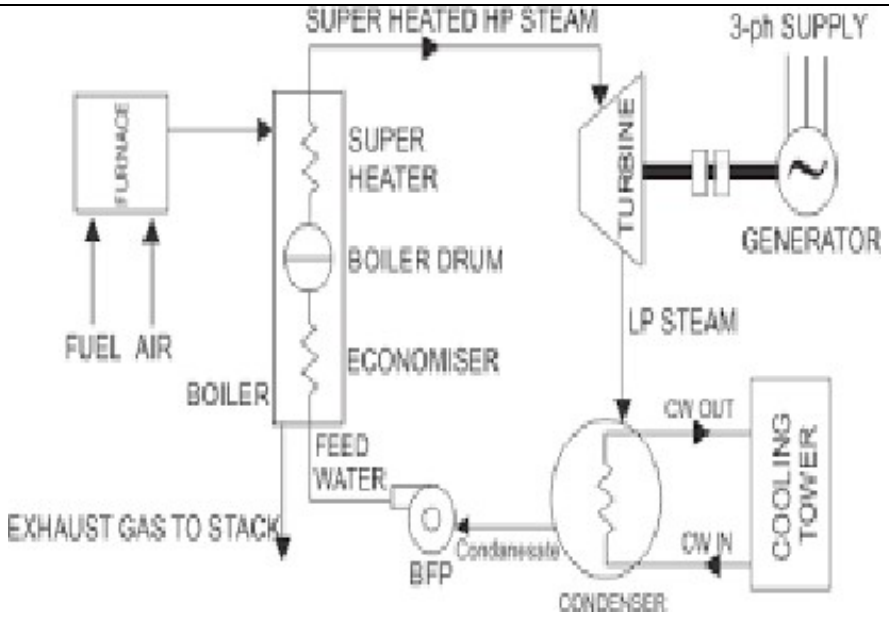
b) Draw a neat layout of typical Thermal power station and label it.

Ans:

Neat layout of typical Thermal power station : **(4 Marks)**



OR equivalent figure



OR equivalent figure

c) State the salient features of constant speed electric generator and variable speed electric generator.

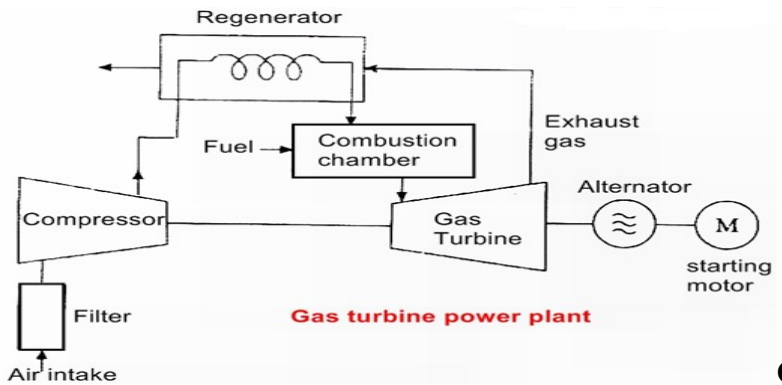
Ans:

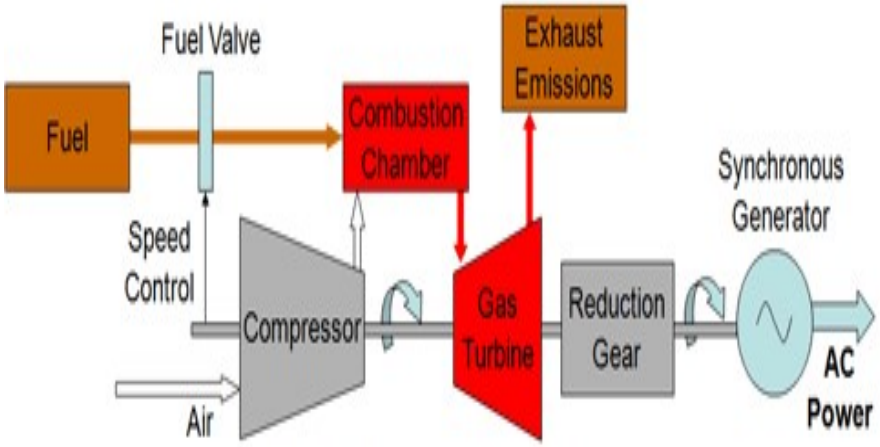
Following are salient features of constant speed electric generator: **(2 Marks)**

1. Less energy capture from wind.
2. Mechanical stresses on wind turbine are more.
3. Pitch controller mechanism is required.
4. These systems have a multiple-stage gearbox so size and weight is more.
5. The power converters not required.
6. Harmonics not present in output voltage.

Following are salient features of variable speed electric generator: **(2 Marks)**

1. More energy capture from wind.
2. Mechanical stresses on wind turbine are less.
3. Noise produced is less.
4. Pitch controller mechanism is not required.
5. This systems is not required multiple-stage gearbox so size and weight is less.
6. The power converters are required.
7. Harmonics are present in output voltage.

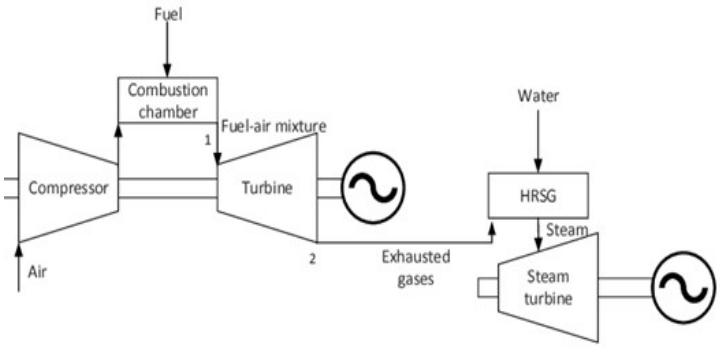
d)	**List any four causes of faults on grid system.**
Ans:	**Following are the causes of faults on grid system or equivalent:** **(Any FOUR Point expected : 1 Mark each point, Total 4 Marks)** 1. Major imbalance between generation and consumption. 2. Low frequency, due to some faults the frequency mismatches then, there is possibility of failure of power grid. 3. Due to breaking of conductor or due to short circuit between two conductors fault occurs which leads to failure of grid. 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).
Q.3	**Attempt any THREE of the following** **12 Marks**
a)	**Draw a block diagram of gas turbine power plant and label each block.**
Ans:	**Block diagram of gas turbine power plant:-** **(4 Marks)**  **OR Equivalent Figure**



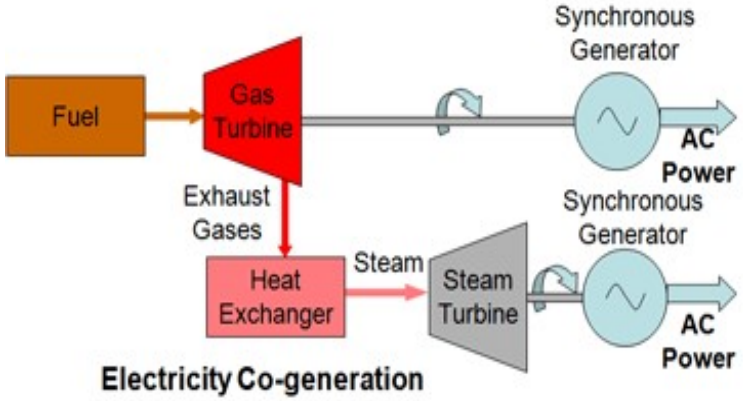
Gas Turbine Electric Power Generation

OR Equivalent Figure

Schematic arrangement for a gas power plant Combined Cycle Systems :-

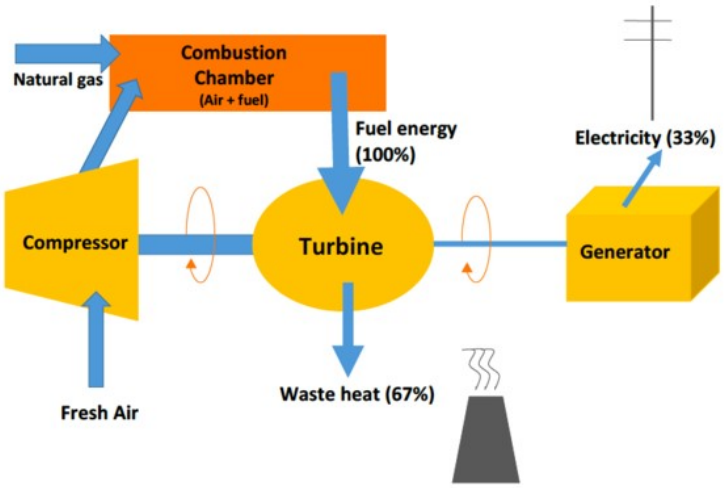


OR Equivalent Figure



Electricity Co-generation

OR

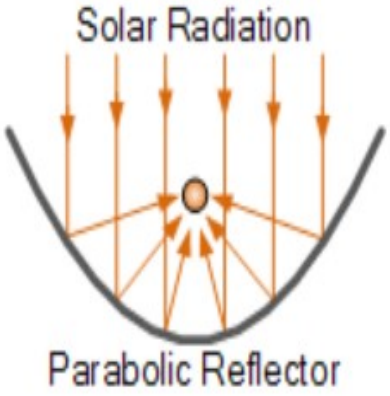


OR Equivalent Figure

b) Explain with sketch the layout and working of parabolic through concentrated Solar Power plant.

Ans: **(Explanation : 2 Marks, Layout : 2 Marks, Total : 4 Marks)**

layout of parabolic trough collector concentrated solar power plants : (2 Marks)



OR equivalent figure

Working: (2 Marks)

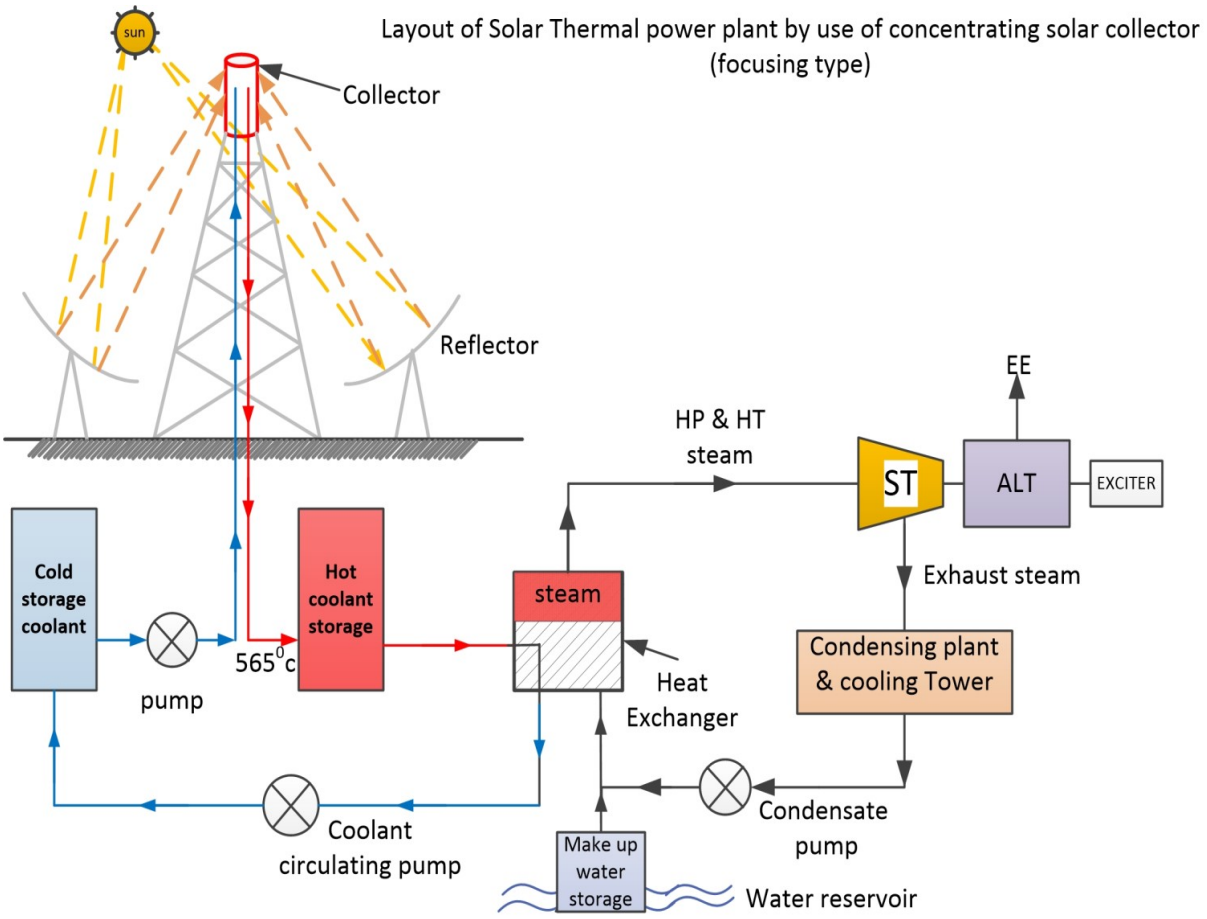
- It consists of disc 6.6 meter in diameter has been made from mirrors formed in to the shape parabola called as concentrator.
- Surface absorber (Receiver) which is well insulated which is located at focal point
- The concentrator captures and reflect solar radiation towards receiver

/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

layout of parabolic trough collector concentrated solar power plants : **(2 Marks)**



OR equivalent Layout

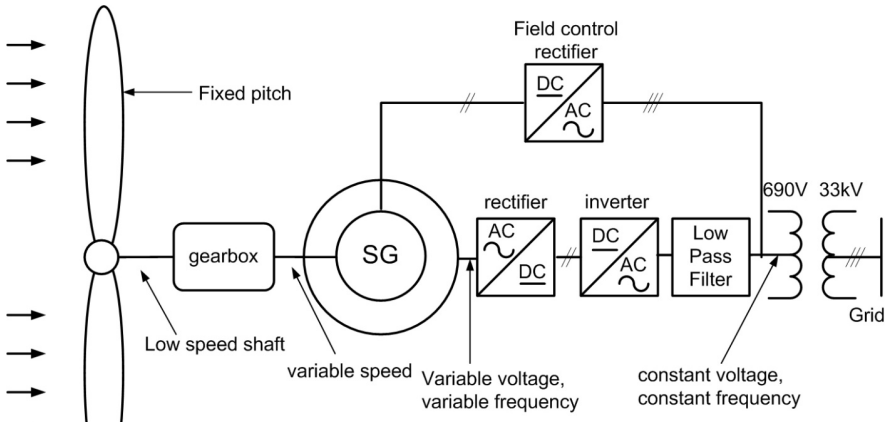
Working: **(2 Marks)**

- 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)	**State any four factors for selection of hydro power plant.**
Ans:	**Following Factors to be kept while site selecting for Hydro power plant:** **(Any FOUR Point Expected : 1 Mark each Point, Total 4 Marks)** 1. It should be located where high rain fall occurs. 2. A large catchments area must be available to store water. 3. It should be located as far as possible in hilly area to reduce construction cost of dam and water reservoir. 4. Stored water should have a reasonable head (Potential Energy). 5. There should be easy access towards the site. 6. Land should have high bearing capacity to reduce the construction cost of dam and for better foundation of machinery. 7. Power plant should be located as far as possible near load center to reduce transmission line cost and losses in it. 8. During the construction of dam, it should be possible to divert the stream of river. 9. The Area should be free from earthquake and natural hazards. 10. It is necessary to see that water is of good quality (i.e.no chemical impurities) because polluted water may cause corrosion.

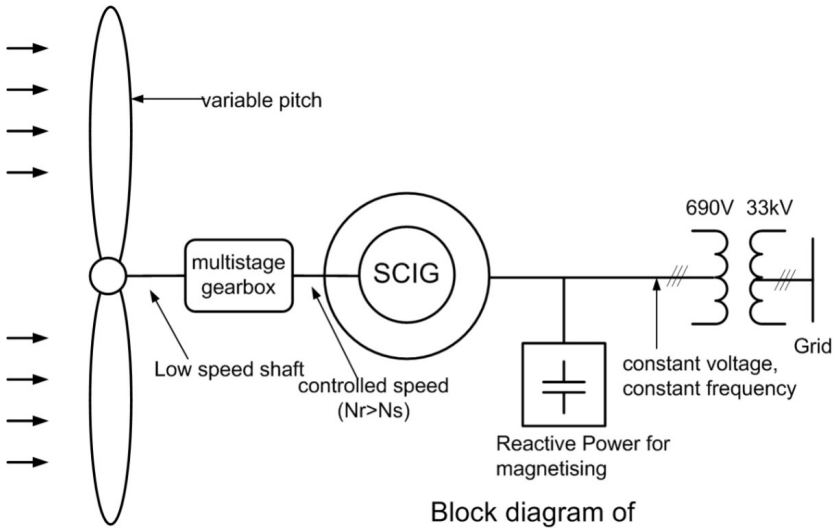
	11. The catchment area should be such that there are less accumulation of slit and debris (Solid Impurities). 12. Cost of land should be less. 13. Skilled and unskilled man power should be available nearby.
d)	**Describe with sketch the layout and working of Geared wind power plant.**
Ans:	**(Any one following figure or equivalent figure may be consider 3 Marks for fig., 1 Mark for explanation, Total 4 Marks)**

OR



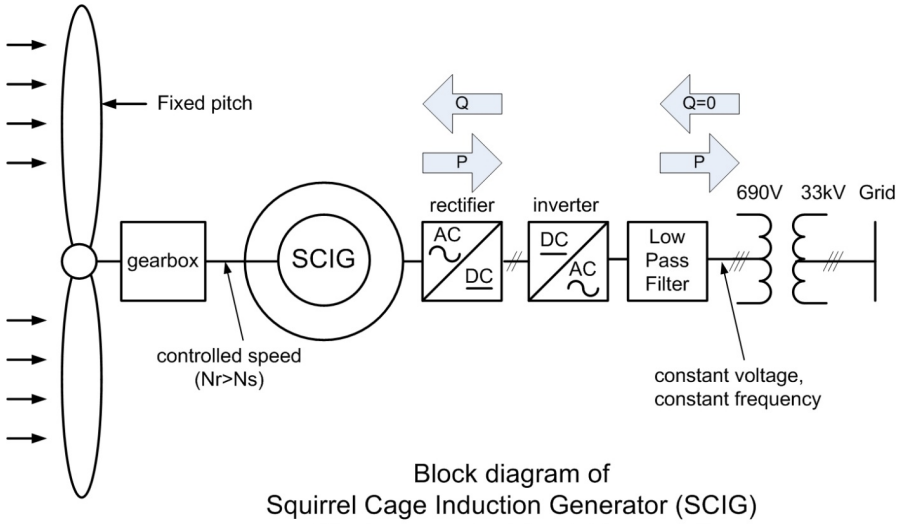
Block diagram of
Wound Rotor Synchronous Generator (WRSG) Wind power plant
(variable speed)

OR



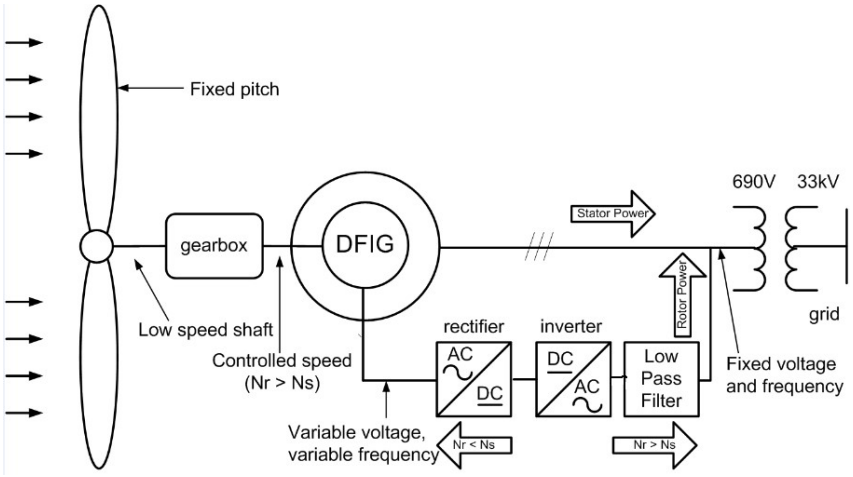
Block diagram of
Squirrel Cage Induction Generator (SCIG) Wind power plant
(constant speed)

OR



Block diagram of
Squirrel Cage Induction Generator (SCIG)
Wind power plant (variable speed)

OR



Explanation:-

Variable speed wind geared wind power plant:-

Because the actual wind speeds are variable, the generator cannot generate electrical power with fixed voltage and frequency magnitude. As a result, they should be connected to the power grid through AC-DC-AC conversion by power converters. That is, the generated AC power (with variable frequency and magnitude) is first rectified into fixed DC and then converted back into AC power (with fixed frequency and magnitude).

Constant speed wind geared wind power plant:-

A gearbox is typically used in a wind turbine to increase rotational speed from a low-speed rotor to a higher speed electrical generator. A common ratio is about 90:1, with a rate 16.7 rpm input from the rotor to 1,500 rpm output for the generator.

Q.4	**Attempt any THREE of the following**	**12 Marks**

a) Explain the purpose of shielding and reflector in a nuclear reactor.

Ans:

Purpose of shielding in Nuclear Power Plant: **(2 Marks)**

Shielding is provided to absorb alpha, beta particles and gama rays which are produced during nuclear chain reaction (fission process)

The function of shielding is to protect environment, humans and animals from the harmful radioactive radiation pollution before they are emitted to atmosphere.

Purpose of reflector in a nuclear reactor: **(2 Marks)**

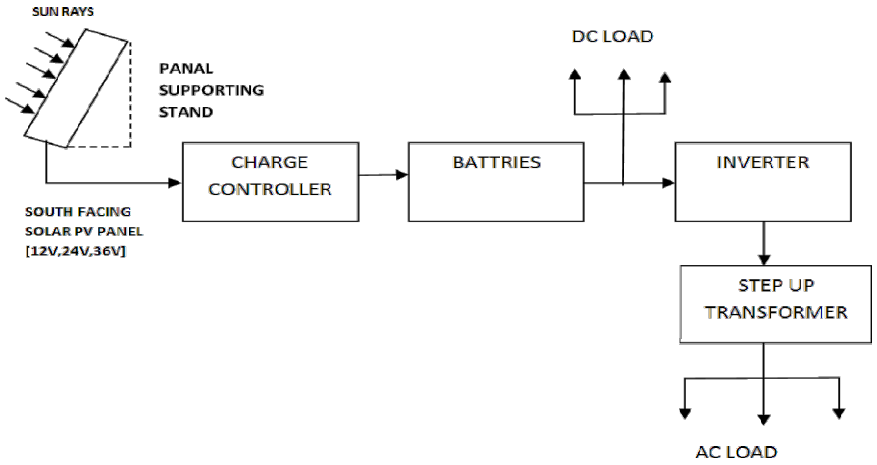
- The function of reflector is to reflect back the neutrons which are leaving from the core.

b) Explain with layout diagram; the construction and 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.

4.Inverter:

It converts DC supply into AC supply.

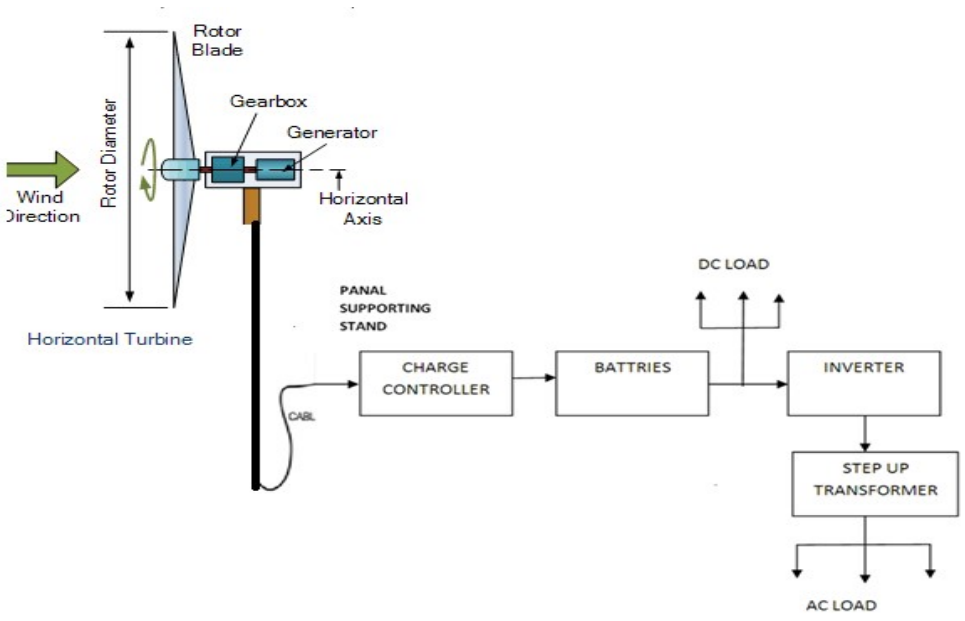
5. Step-up transformer:

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

c) Describe the layout and working of the horizontal and vertical axis small wind turbines.

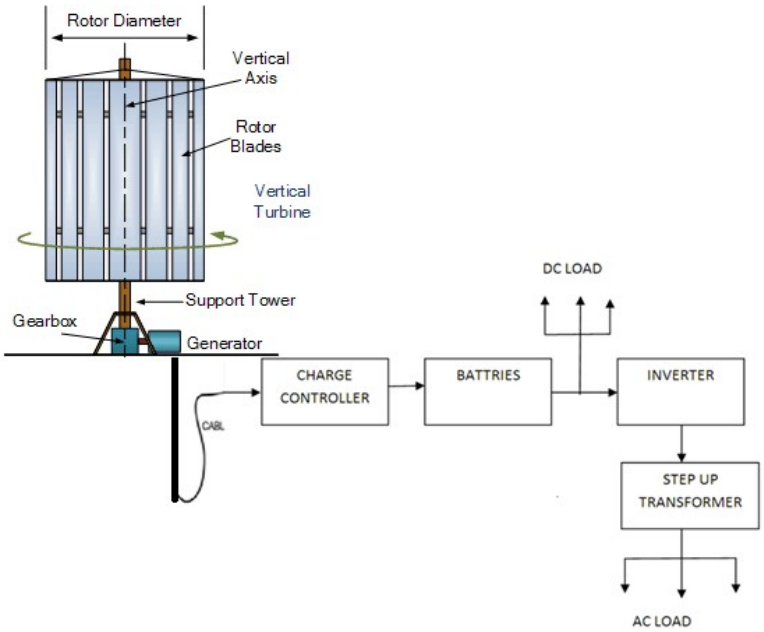
Ans: **(Following figure or equivalent figure may be consider 3 Marks for fig., 1 Mark for explanation, Total 4 Marks)**

i) Diagram of Horizontal axis wind turbine



or equivalent figure

ii) Diagram of Vertical axis wind turbine



or equivalent figure

Explanation:-

1. **Horizontal axis wind turbine :-** Axis of rotation is parallel to the ground

   Vertical axis wind turbine:- Axis of rotation is perpendicular to ground

2. Battery charge Controller:

It protects battery from over charging in this way itincreases life of storage battery.

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 convert DC supply into AC supply..

5. Step-up transformer:

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

d)	**Define : (i) Max Demand (ii) Average Demand (iii) Plant capacity factor (iv) Plant use factor**

Ans:

(Each definition 1 mark ,Total 4 Marks)

i) Maximum Demand: **(1 Mark)**

It is the maximum load which a consumer uses at a particular time period out of his total connected load.

ii) Average Demand :- **(1 Mark)**

$$\text{Daily Average Demand} = \frac{\text{Number of units generated (KWH) in one day}}{\text{Number of hours in a day (24 hours)}}$$

OR

$$\text{Monthly Average Demand} = \frac{\textit{Number of units generated (KWH) in month}}{\textit{Number of hours in a month}}$$

OR

$$\text{Yearly Average Demand} = \frac{\text{Number of units generated (KWH) in one Year}}{\text{Number of hours in one year}}$$

iii) 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

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

iv) Plant use Factor:- **(1 Mark)**

The definition such that the ratio becomes the amount of energy **used** divided by the maximum possible to be **used**.

It is the ratio of number of unit (kWh) generated to the product of plant capacity and the number of hours for which plant was in operation.

OR

$$i.e\ plant\ use\ factor = \frac{Station\ output\ in\ kWh}{Plant\ capacity \times hours\ of\ use}$$

e) Compare base load and peak load power plants.

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

Sr.No.	Points	Base load plant	Peak load plant
1	Definition	The power plant which supplies base load of load curve is known as base load plant	The power plant which supplies peak load of load curve is known as peak load plant
2	Generating capacity	High	Low
3	Firm capacity	High	Low
4	Working Hours	24 hours	Only during peak load hours
5	Starting time	Both quick & more starting time power plant can be selected as a base load plant	Quick starting time power plant are selected as a peak load plant
6	Load factor	High	Low
7	Capacity Factor	High	Low
8	Plant use factor	High	Low
9	Examples	Large capacity hydro, thermal, nuclear power station	Small capacity storage hydro, pumped storage hydro, gas, diesel power station.

Q.5	Attempt any TWO of the following	12 Marks
a)	**State the types of radioactive wastes generated in a nuclear power station. Explain the methods employed for their disposal.**	

Ans:

➢ **Types of radioactive waste**:

The waste produced in nuclear power plant is in the form of :-

1. Solid Waste
2. Liquid Waste
3. Gases Waste

1. Solid Waste Disposal:- **(2 Marks)**

- 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 reduces 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.

OR

- Solid waste is filled in a sealed container and is disposed off away from sea shore.

OR

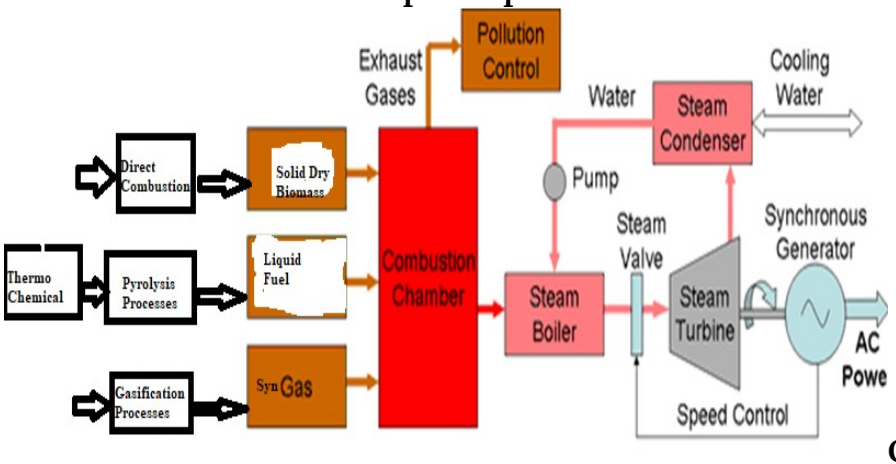
- Many times old and unused coal mines, salt mines, can be used for waste disposal

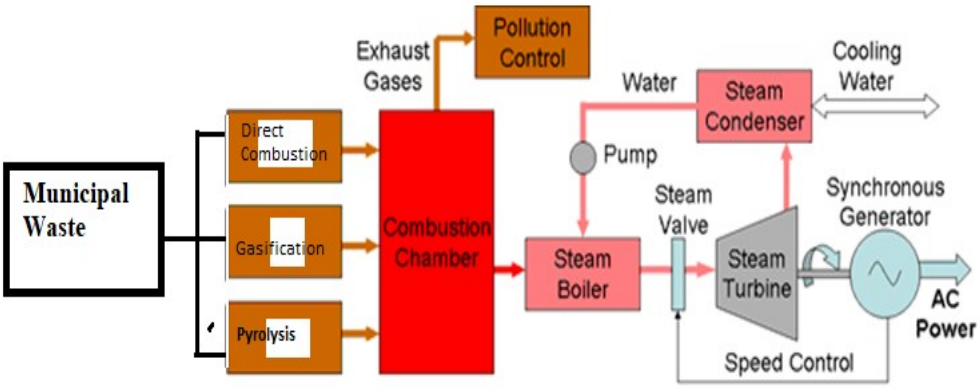
2. Liquid Waste Disposal:- **(2 Marks)**

- 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.

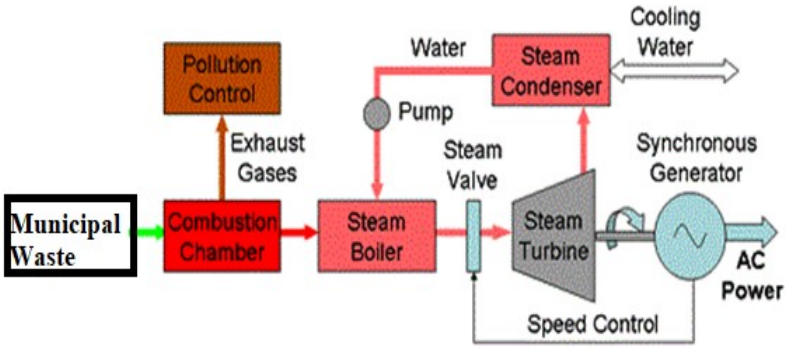
3. Gaseous Waste Disposal:- **(2 Marks)**

- 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)	**State the functions of the following parts of hydroelectric power station: (i) Reservoir (ii) Tailrace (iii) Spillway (iv) Surge tank (v) Forebay (vi) Turbine**
Ans:	**(Each definition : 1 Mark each, Total 6 Marks)** **(i) Function of Reservoir:-** **(1 Marks)** Its function is to store the water during rainy season and supplies the same throughout the year. **ii) Function Tail race:-** **(1 Marks)** To carry the water leaving from turbine. **iii) Spillways: -** **(1 Marks)** ➢ Its function is to 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. **iv) Surge Tank:-** **(1 Marks)** ➢ It protects penstock from water hammer effect when load on turbine reduces. ➢ It avoids cavity effect in penstock when load on turbine increases. **v) Fore bay:-** **(1 Marks)** ➢ Fore bay stores more quantity of water at intake. ➢ It performs the function of surge tank for small and medium head power plant. **vi) Turbine:** **(1 Marks)** It function is to convert kinetic energy of water into mechanical energy.
c)	**Explain with sketch; the layout of a thermo chemical based (municipal waste) power plant.**
Ans:	**(Explain 3 Marks and layout 3 Marks, Total 6 Marks)** **Layout of a thermo-chemical based power plant:** **(3 Marks)**  **OR**



OR Equivalent Figure



Explanation of Thermo chemical based (municipal waste PP):- **(3 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

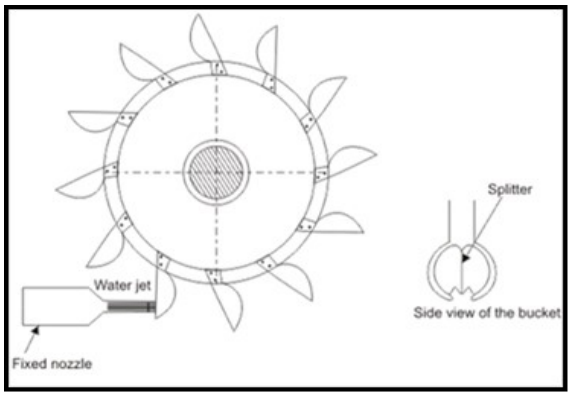
Which can be used to produce heat energy. This heat energy is used to produce high pressure and high temperature steam. This steam is used to run the steam turbine. Steam turbine is coupled with generator to produce electrical energy.

Q.6	Attempt any TWO of the following	12 Marks
a)	**Explain with sketches the construction and working of the Pelton turbine used for high head power plant.**	

Ans:

(Diagram : 2 Marks, Construction : 2 Marks & Working : 2 Marks, Total 6 Marks)

Diagram of Pelton Wheel:- **(2 Marks)**



OR equivalent Sketch

Construction : **(2 Marks)**

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: **(2 Marks)**

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.

b)	**Describe the features of solid, liquid and gas biomasses as fuel for biomass power plant.**
Ans:	**(2 Marks each ,Total 6 Marks)**

Features of solid biomasses fuels:-

1. Ash is high.
2. Low thermal efficiency
3. Low calorific value and require large excess air.
4. Cost of handling high

Features of liquid biomasses fuels:-

1. High calorific value
2. No ash produces

3. Ignite easily
4. Firing can be controlled easily

Features of Gaseous biomasses fuels :-

1. High calorific value
2. No ash produces
3. Ignite easily
4. Firing can be controlled easily

OR

Biomass fuels:-

1. Bagasse (Sugar cane waste)
2. Agriculture residual
3. Forestry residual
4. Energy trees/crop plantation/energy crops
5. Dead trees and tree branches
6. Wood processing industrial waste
7. Food processing industrial waste
8. Horticulture
9. Residential, commercial and industrial waste
10. Municipal waste
11. Hotels, resorts waste
12. Peels of fruits
13. Coconut shell
14. Ground nut shell
15. Vegetable waste

c)	**The peak load on a power station is 30 MW. The loads having maximum demands of 25 MW, 10 MW, 5 MW and 7 MW are connected to the power station. Capacity of the power station is 40 MW and annual load factor is 50%. Find: (i) Average load on power station (ii) Energy supplied per year (iii) Demand factor (iv) Diversity factor**
Ans:	**Solutions:**

i) The maximum demand on the power station is **30 MW**

Maximum Demand: 30 x 10^3 KW ---------- **(1 Mark)**

ii) Energy supplied by the plant in year =

$$= M.D \times L.F \times 8760$$

$$= 30 \times 10^3 \times 0.50 \times 8760$$

$$= 131400000$$

$$= 131400 \times 10^3 \ KWh$$ ---------- **(1 Mark)**

iii)Average Load =

$$= \frac{Units\ generated\ in\ plant}{8760}$$ ---------- **(1/2 Mark)**

$$= \frac{131400 \times 10^3}{8760} = 15 \times 10^3 \ KW$$

$$= 15 \times 10^3 \ KW$$ ---------- **(1 Mark)**

iv) Diversity Factor =

$$= \frac{Sum\ of\ individual\ consumer\ M.D}{Maximum\ demand\ on\ generating\ Station}$$ ---------- **(1/2 Mark)**

$$= \frac{10^3\ (25+10+5+7)}{30 \times 10^3}$$

= 1.5666 ---------- **(1 Mark)**

v) Demand Factor =

$$= \frac{Maximum\ Demand}{Install\ Capacity\ of\ the\ power\ Station}$$

$$= \frac{30 \times 10^3}{40 \times 10^3}$$

$$= 0.75$$ ---------- **(1 Mark)**

$$= 75\ \%$$

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