



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 TEN of the following	20 Marks
a)	List any four sources of energy.	
Ans:	List of sources of energy:- (Any four sources of energy are expected 1/2 Mark each) 1. Hydro energy (P.E. of water) 2. Nuclear energy (Heat is produced by fission processes of U235) 3. Fossil fuels: i) Thermal energy (by combustion of coal) ii) Natural gas energy (by combustion of natural gas consists mainly methane.) iii) Diesel/Petrol energy 4. Solar Energy: i) Photovoltaic Systems (Direct conversion to electricity) ii) Solar Thermal Power plant (In direct conversion to electricity) 5. Ocean Energy:	



	<p>i) Ocean Tidal Energy</p> <p>ii) Ocean Wave Energy</p> <p>iii) Ocean Thermal Energy</p> <p>6. Geothermal Energy</p> <p>6. Bioenergy:</p> <p>i) Biofuels (e.g. Bio-diesel, Ethanol)</p> <p>ii) Biomass (e.g. sugar cane bagasse, farming waste, forestry waste etc.)</p> <p>iii) Biogas (it is produced from any organic waste materials. It contains mixture of methane (50-65 % in volume) and carbon dioxide</p> <p>7. Fuel Cells (hydrogen)</p>																																										
b)	Name any two thermal power stations in Maharashtra State with their installed capacity.																																										
Ans:	<p style="text-align: center;">(Any Two power plant name expected: 1 Mark each, Total 2 Mark)</p> <table border="1"><thead><tr><th>Sr.No.</th><th>Name of Thermal Power Plant</th><th>Plant Capacity</th></tr></thead><tbody><tr><td>1</td><td>Koradi</td><td>1100 MW</td></tr><tr><td>2</td><td>Nashik</td><td>910 MW</td></tr><tr><td>3</td><td>Chandrapur</td><td>2340 MW</td></tr><tr><td>4</td><td>Parali</td><td>1130 MW</td></tr><tr><td>5</td><td>Bhusawal</td><td>920 MW</td></tr><tr><td>6</td><td>Paras</td><td>500 MW</td></tr><tr><td>7</td><td>Khaparkheda</td><td>1340 MW</td></tr><tr><td>8</td><td>TATA (Trombay)</td><td>1400 MW</td></tr><tr><td>9</td><td>Dhahanu (Thane)</td><td>500 MW</td></tr><tr><td>10</td><td>Wardha</td><td>135 MW</td></tr><tr><td>11</td><td>Amravati</td><td>2700 MW</td></tr><tr><td>12</td><td>Jindal (Ratnagiri)</td><td>1200 MW</td></tr><tr><td></td><td></td><td></td></tr></tbody></table>	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			
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c)	State any two salient features of turbo alternator.
Ans:	Special Features of alternators (Hydro generator) of HPS:- Or Similar features (2 Marks) 1. Hydro generator is large diameter and small is length. 2. Hydro-generator is low speed machine compare to the steam turbine driven generator. OR Special Features of alternators (Thermo generator) of TPS:- Or Similar features 1. Alternator is smaller in diameter and longer in axial length. 2. Alternator is high speed machine compare to the water turbine driven generator.
d)	State the purpose of surge tank and spill way in hydroelectric power station.
Ans:	Surge tank :- (1 Mark) A surge tank is the small reservoir or tank. It is open at the top. It is installed near Valve house of turbine. ➤ It avoids water hammer effect when load on turbine reduces. (It stores immediately the rejected water. ➤ It avoids cavity effect when load on turbine increases. (It supply immediately the water) Spill way :- (1 Mark) ➤ It acts as a safety valve for a dam. ➤ It discharges excess water when head of water increases above predetermine maximum level, at the time of heavy rainfall & during floods etc. ➤ In this way spill way avoids damage of dam due to excess pressure of water.
e)	Classify hydropower plant on the basis of availability of water head.
Ans:	Classify hydropower plant on the basis of availability of water head: (2 Marks) 1. Low head power plant (Below 30m) 2. Medium head power plant (30 to 300 m) 3. High head power plant (above 300m)
f)	State any two fuels used in nuclear power station.
Ans:	Two fuels used in nuclear power station. (Any Two expected: 1 Mark each) 1. Natural Uranium



	<p>2. Low –enriched Uranium</p> <p>3. Highly –enriched Uranium</p> <p>4. Fertile Material:- U^{238} / Th^{232}</p>																											
g)	State the purpose of moderator in a nuclear power plant.																											
Ans:	Following purpose of moderator in a nuclear power plant: (2 Marks) <p>The function of moderator is to moderate or reduce the speed of fast neutron to help the fission process.</p>																											
h)	State location of any four nuclear plants in India.																											
Ans:	Name of the location of any four nuclear plants in India: (Any Four power plant name expected: 1/2 Mark each, Total 2 Mark)																											
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i)	Give the classification of diesel engines.																											
Ans:	Following classification of diesel engines: (2 Mark) <p>1) Two Stroke Diesel Engine</p> <p>2) Four Stroke Diesel Engine</p>																											
j)	State any two applications of diesel power plants.																											
Ans:	(Any Two Applications of Diesel Power Plant expected: 1 Mark each, Total 2 Mark) Applications of Diesel Power Plant: <p>1. It can be used as a standby (emergency) power plant to maintain continuity of supply. (Incase failure of main supply like hospital, Telephone exchange Radio stations, Colleges, and cinema Theaters.)</p> <p>2. It is suitable where power requirement is small.</p> <p>3. It is suitable as a peak load power plant for short duration.</p>																											



	<p>4. It is widely used in transportation system. e.g. Elect. Traction, Ship, Aero plane etc.</p> <p>5. Mobile DEPP mounted on vehicle is used in emergency requirement and for temporary supply purpose.</p> <p>6. It is used in remote places where supply from grid is not available.</p> <p>7. It is very economical to supply power to small scale industry which works for seasonal period.(For short period in a year)</p> <p>8. The use of such plant is very common during construction stage of HPP/TPP/NPP and other construction.</p> <p>9. The diesel units can be used to supply the auxiliaries for starting the large thermal plants.</p>
k)	Define state grid and national grid.
Ans:	<p>1) State Grid : (1 Mark)</p> <p>When all the major generating stations in state are interconnected to each other through transmission line, it forms a state grid system</p> <p>2) National Grid : (1 Mark)</p> <p>All state grids are interconnected to each other through transmission line; it forms a national grid system</p>
l)	Define diversity factor of power plant.
Ans:	<p>Diversity Factor:- (2 Mark)</p> <p>The ratio of the sum of the individual consumers, maximum demand to the maximum demand on power station.</p> <p style="text-align: center;">OR</p> <p>Diversity Factor = $\frac{\text{Sum of individual consumers maximum demand}}{\text{Maximum demand on power station}}$</p>



Q.2	Attempt any FOUR of the following :	16 Marks																																								
a)	Compare conventional energy sources with non-conventional energy sources (any four points).																																									
Ans:	(Any Four Point expected: 1 Mark each, Total: 4 Mark)																																									
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b)	Draw a neat layout of thermal power station and label it.																																									
Ans:	layout of thermal power station and label it:	(4 Mark)																																								
	<p style="text-align: center; color: red;">Thermal Power Plant</p>																																									



<p>c)</p> <p>Ans:</p>	<p>State the function of cooling tower and condenser in thermal power station.</p> <p>1. <u>Condenser:</u> (2 Mark)</p> <ul style="list-style-type: none">➤ Function of condenser is to convert exhaust steam again into water by reducing its temperature with the help of cold water.➤ Also it reduces back pressure of steam turbine <p>2. <u>Cooling tower :</u> (2 Mark)</p> <p>The function of cooling tower is to reduce the temperature of water coming from condenser.</p>
<p>d)</p> <p>Ans:</p>	<p>State the various factors governing selection of site for thermal power station.</p> <p>Following points are considered while selecting site for thermal power station :-</p> <p style="text-align: right;">(Any Four factors are expected: 1 Mark each)</p> <ol style="list-style-type: none">1. Distance from coal mines :- The power plant should be located near the coal mines, to reduce cost of fuel transportation.2. Availability of Water :- Water is as good as secondary fuel so ample amount of water should be available nearby. So, plant should be located near large water reservoir, lake, river or ocean.3. Easy access :- There should be easy access towards site of power plant for transportation of machinery, equipments, man power, fuel etc.4. Availability of land :- Sufficient large space should be available to build the power plant, for storage of coal, for storage of ash, for staff quarters and also for Future expansion of the power plant. Also, the plant should be constructed on plane land.5. Cost of land :- Cost of land should be less to reduce capital cost of power plant.6. Condition of land soil:- The land should have high bearing capacity. It should not be too loose or too hard, for economical and better foundation of machinery, equipment and buildings.7. Distance from populated area:- As TPP produces air pollution, PP should be located away from populated area.8. Near Load Centre :- Power Plant should be located near load center to reduce transmission cost & transmission Losses.9. Away from airport :- As height of chimney is very high, it should be located away from airport.



	<p>10. Availability of labor:- Skilled and unskilled labor should be available nearby.</p> <p>11. Earthquake :- Area should be free from earthquake and other natural hazards.</p>
e)	Define the terms: i) Hydrology ii) Surface Runoff iii) Evaporation iv) Precipitation.
Ans:	<p>1) Hydrology: (Each Definition: 1 Mark each)</p> <p>➤ It may be defined as the science which deals with the depletion and replenishment of water resources.</p> <p style="text-align: center;">OR</p> <p>To study hydrological cycle i.e. i.e. evaporation, precipitation and to estimate the yearly possible flow.</p> <p>2) Surface run-off :</p> <p>It is that portion of precipitation (rain fall) which actually flow towards stream, lake, river or ocean.</p> <p>Run-off can be possible only when the rate of precipitation is more than rate of absorption of water in soil and also evaporation losses.</p> <p>Run-off = Total precipitation – total evaporation of water</p> <p>3) Evaporation:</p> <p>It is the transfer of water from liquid state to vapor state.</p> <p>4) Precipitation :</p> <p>Precipitation is nothing but rain fall. This includes all the water that falls from atmosphere (sky) to the earth surface.</p>
f)	State the advantages and disadvantages of hydroelectric power plant.
Ans:	<p>Advantages of Hydroelectric power plant:-</p> <p style="text-align: center;">(Any Two advantages are expected: 1 Mark each)</p> <ol style="list-style-type: none">1. There is no air pollution and other environmental problems.2. The fuel (water) is available freely.3. No fuel transportation cost so; there is no necessity of fuel handling equipment.4. No treatment on fuel is required.5. No fuel waste is produced (like ash) so, no waste disposal problem.



6. Fuel can be used again and again. (Renewable energy sources)
7. Generating cost is less and reduces day by day.
8. Power plant can be put into service immediately.
9. It saves fossil fuels (coal diesel oil etc.) which are limited available which can be used for other purposes.
10. Less man power is required per MW so, running cost is less.
11. Layout is simple. Auxiliaries are considerably less than those in the case of a thermal power station.
12. Power generation can be controlled quickly & rapidly without any difficulty. (By simply controlling flow of water)
13. There are no standby losses.
14. Efficiency of plant is highest (above 97%) and does not change with age.
15. Operating & maintenance cost are very low.
16. The life of plant is longest.
17. In addition to generation of electric energy H.P.P. is also useful for supply of drinking water, supply of water for irrigation purpose and it control the flood also.
18. Since, hydroelectric stations are situated far away from populated areas so, the cost of the land is low.
19. The cost per kWh of a hydroelectric station is not considerably affected by the load factor, as in the case of a TPP NPP DPP.
20. It is very neat & clean plant.

Disadvantages of hydroelectric Power Stations:-

(Any Two disadvantages are expected: 1 Mark each)

1. High capital cost due to construction of dam.
2. It takes long time for completion of power plant.
3. It requires large space (catchment) for storage of water.
4. As power plant are away from load center so the cost of transmission and losses in it are more.
5. Power generation depends on nature.
6. During long dry season it affects the capacity of power generation.
7. Firm power (Output) is totally depends on quantity of water available in reservoir.



	<p>8. There is limitation to select the site of HPP because of their site selection criteria.</p> <p>9. The building of large dams can cause serious geological damage.</p> <p>10. Due to construction of dam and creating large reservoir, this can force the <u>relocation of large numbers of riverside cities, towns, villages & people.</u></p>
Q.3	Attempt any FOUR of the following : 16 Marks
a)	State the different types of fuels with two examples of each. State the advantages and disadvantages of these fuels.
Ans:	<p style="text-align: center;">(Note : Any relevant answer may be consider) :</p> <p>Different types of fuels : (4Marks)</p> <p>Solid Fuels :-</p> <ol style="list-style-type: none">1. Coal2. Bagasse3. Wood <p>Gases Fuels :-</p> <ol style="list-style-type: none">4. Natural gas5. Bio gas <p>Liquid Fuels :-</p> <ol style="list-style-type: none">6. Kerosene and diesel7. Petrol <p style="text-align: center;">OR</p> <ol style="list-style-type: none">1. Indian Coal : It contain 30 to 40 % ash but sulphur content is less than 1%..2. Imported coal: It contents low ash about 10% but sulphur content is more (1.2%).3. Liquid fuels: Oil, diesel can be used to generate steam but it is not economical.4. Gases fuel: Natural gas or manufactural gas can be used to generate steam. But transportation and storage of gas is big problem.5. Biomass fuel: Solid biomass fuel can be used to generate steam by burning directly in furnace. e.g. Agriculture waste, forestry waste, vegetable waste, commercial waste ,animal waste ,crops refuses, peel (cover) of fruits, domestic refuses etc.6. Bagasse: -Waste of sugar cane.7. Nuclear Fuel: Heat is produced by chain reaction of U^{235}. <p style="text-align: center;">OR</p> <p>Following types of fuels:</p> <ol style="list-style-type: none">1. Solid Fuel : Coal, U^{235}2. Liquid fuel: Diesel, Petrol and water3. Gases: Natural gas, gas and Biogas



OR

Types of fuels	
A	BIOMASS
1	Wood
2	Cattle dung
3	Bagasse
4	Wheat and rice straw
5	Cane trash, rice husk, leaves and vegetable wastes
6	Coconut husks, dry grass and crop residues
7	Groundnut shells
8	Coffee and oil palm husks
9	Cotton husks
10	Peat
B	FOSSIL FUELS
1	Coal
2	Coke
3	Charcoal
4	Carbon
5	Fuel oil
6	Kerosene and diesel
7	Petrol
8	Paraffin
9	Natural gas
10	Coal gas
11	Electrical (Kcal(KW))
12	Bio gas(Kcal/cu mtr) (12 kg of dung produces 1 cu. Mtr gas)

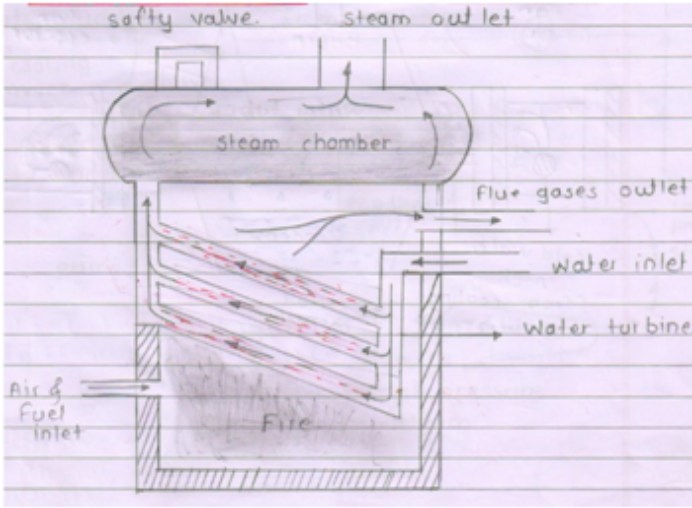
OR

1. Water or Hydro
2. Fuel used as a high grade coal,
3. Fuel used as a natural oil and gas
4. Fuel used as a diesel
5. Atomic or Nuclear Energy

OR

- i) The sun energy
- ii) The wind energy
- iii) Geothermal Energy
- iv) Ocean Tides, Waves or thermal energy
- v) Biomass energy



	<p>Advantages & disadvantages of gases and liquid fuels over Solid fuels:</p> <ol style="list-style-type: none">1) Due to liquid/ gases fuel amount fuel required to produce same amount of heat reduces.2) Time required for combustion reduces.3) It gives more heating surface area.4) High temperature can be produce in furnace.5) It requires low air pressure.6) The requirement of air for complete combustion is reduced.7) Because of the smaller requirement of air and through mixing of air and fuel, very high-combustion temperatures can be attained.8) Firing of liquid fuel is easy.9) The firing can be controlled to match the load requirements.10) Rapid and efficient starting of the boilers from cold.11) Less furnace volume required.
<p>b)</p>	<p>Draw a neat labelled sketch of water tube boiler and also State its two advantages over fire tube boiler.</p>
<p>Ans:</p>	<p>Sketch of water tube boiler:- (2 Marks)</p>  <p>Advantages over fire tube boiler. :- or equivalent figure (Any Two Point expected: 1 Mark each)</p> <ol style="list-style-type: none">1. Steam at high pressure and high temperature is generated.



	<ol style="list-style-type: none">2. Rate of steam generation for per hour is more.3. Steaming time is very less.4. The output of the boiler is high.5. High efficiency.6. Better control on temperature of steam.7. Respond quickly to change in steam demand.8. Its weight is less.9. Suitable for large capacity thermal power plant.
c)	Write the purpose of coal and ash handling unit. Also write different activities that are carried out in this unit.
Ans:	Purpose of coal and ash handling unit :- (2 Mark) <ul style="list-style-type: none">➤ To transport coal from coal storage to power plant.➤ A large quantity of ash about 10 to 30 % produced in furnace, the removal of ash from boiler furnace is necessary for efficient combustion. Different activities :- 1. Coal Handling Activity:- (Any one point expected: 1 Mark) <u>Coal Delivery:-</u> Coal from supply point (mines) is delivered to TPP by dumper or railway or in case of power plant, which are located near sea-shore are delivered by ship. <u>Coal unloading:</u> It is done by machinery not manually. e.g. With the help of rotary car dumper or crane etc. <u>Coal Storage:</u> It is desirable that sufficient quantity of coal should be store at generating station. Because large quantity of coal is required for generation. There are two types of storage: 1. Outdoor storage (Dead storage) 2. Indoor storage (live storage) <u>Preparation of coal:</u> <ul style="list-style-type: none">➤ In the plant coal is crushed into small pieces with the help of crusher and breaker. The coal is crushed to 2.5 cm. or less.



	<ul style="list-style-type: none">➤ Then it is cleaned by passing forced air to remove the dust contain.➤ Moisture is removed with the help of dryer. The moisture content must be less than 2% after drying operation.➤ This coal is passed through magnetic separator to separate the iron particles mixed in it.➤ Now, coal is passed to pulverizing mill. <p><u>Coal Weighing:</u> Before sending pulverized coal to the furnace, its weight is taken.</p> <p>2. Ash Handling Activity:- (Any one point expected: 1 Mark)</p> <p>Handling of ash coming out from furnace is a problem because.</p> <ul style="list-style-type: none">➤ Ash is too hot.➤ It is dusty.➤ It contains some poisonous gases <p>Hence before handling it is desirable to quench the ash due to following reasons.</p> <ul style="list-style-type: none">➤ It reduces temperature of ash.➤ It reduces dustiness. <p>Handling of ash includes:</p> <ul style="list-style-type: none">➤ Removal of ash from furnace.➤ Load on conveyer belt.➤ Deliver to the space where it can be disposed off. <p>Various methods of disposal of ash:</p> <ul style="list-style-type: none">➤ Mechanical system.➤ Pneumatic system.
d)	State the functions of the following parts of hydroelectric power station : i) Reservoir ii) Penstock iii) Tailrace iv) Turbine
Ans:	<p>1) Reservoir:- (Function of each part : 1 Mark)</p> <p>.Its purpose is to store the water during rainy season (High flow period) and supplies the same throughout the year to run the water turbine.</p> <p>2) Penstock:-</p> <p>It function is to carry water from the water intake (reservoir) to turbine.</p> <p>3) Tailrace:</p> <ul style="list-style-type: none">➤ The water after running the turbine is to be discharged.➤ The tailrace is nothing but free exit of water and a passage to the jet of water



	leaving the turbine. 4) Water Turbine: It converts kinetic energy of water into mechanical energy.
e)	Define the terms nuclear fission and chain reaction as referred to nuclear power station.
Ans:	Nuclear fission:- (2 Marks) The heat energy released can be obtained by breaking up heavy nuclei (atoms) into nuclei of intermediate size, the process being known as fission. Chain reaction :- (2 Marks) When nuclear fuel U^{235} or Pu^{239} when strikes by a slow neutron in nuclear reactor than it under goes nuclear reaction at that time ; <ul style="list-style-type: none">➤ Huge amount of heat energy is liberated and➤ Two or three neutron are produced➤ $\alpha, \beta, \& \gamma$ rays are produced➤ Beryllium & krypton are also produced. Due to two or three neutron chain reaction is continuous till most of the original nuclei in the given sample are fissioned is called as chain reaction.
f)	State why nuclear power plants are used as base load plants and diesel power plants as a peak load plant. (Give two reasons).
Ans:	1. Because of following points Nuclear power plant used as base load power plant:- (Any Two point expected: 1 Mark each) <ol style="list-style-type: none">1. Nuclear power plants is very economical for producing bulk amount of electric power2. Nuclear power plant is reliable in operation.3. Nuclear power plant are not affected by adverse weather conditions.4. Nuclear energy is outstanding as compare to any other type of energy sources.5. Large amount of nuclear fuel is available in nature .6. Nuclear fuels do not produce carbon dioxide or sulfur dioxide so it produces less air pollution.



	<p>1. Because of following points diesel power plant used as peak load power plant:- (Any Two point expected: 1 Mark each)</p> <ol style="list-style-type: none">1. Diesel power plant is quick starting.2. Diesel power plant response quickly to load variation.3. The plants can be put on load easily.4. Diesel engines take less time to make OFF.																
Q.4	Attempt any FOUR of the following : 16 Marks																
a)	Compare jet condenser with surface condensers for initial cost, maintenance cost and space required for condensation.																
Ans:	(4 Mark)																
	<table border="1"><thead><tr><th>Sr.no.</th><th>Points</th><th>Jet condenser</th><th>Surface condenser</th></tr></thead><tbody><tr><td>1</td><td>Initial cost</td><td>Low manufacturing cost.</td><td>High manufacturing cost</td></tr><tr><td>2</td><td>Maintenance cost</td><td>Low maintenance cost.</td><td>High maintenance cost.</td></tr><tr><td>3</td><td>Space Required</td><td>Requires small floor space.</td><td>Requires large floor space.</td></tr></tbody></table>	Sr.no.	Points	Jet condenser	Surface condenser	1	Initial cost	Low manufacturing cost.	High manufacturing cost	2	Maintenance cost	Low maintenance cost.	High maintenance cost.	3	Space Required	Requires small floor space.	Requires large floor space.
Sr.no.	Points	Jet condenser	Surface condenser														
1	Initial cost	Low manufacturing cost.	High manufacturing cost														
2	Maintenance cost	Low maintenance cost.	High maintenance cost.														
3	Space Required	Requires small floor space.	Requires large floor space.														
b)	Explain the working of pumped storage plants.																
Ans:	Working of pumped storage hydroelectric power plant:- (4 Mark) <ul style="list-style-type: none">➤ It consists of <u>head water pond</u> (reservoir) and <u>tail water pond</u> by constructing a <u>dam at tail race path</u>.➤ Tail water pond and head water pond connected through penstock.➤ <u>During peak hours</u> the turbine drives the generator and generates electrical energy.➤ The excess energy generated by steam and nuclear plants during the off-peak load is utilized to drive the motors in the pumped storage plants➤ <u>During OFF</u> peak hours the <u>generator operates as a motor</u>. And drives the <u>turbine</u> which now works as <u>centrifugal pump</u>.➤ Raising the water from tail water pond to head water pond through penstock.																



c)	State any four advantages and any four disadvantages of diesel electric power plant.
Ans:	<p>Advantages of Diesel electric power plant:-</p> <p style="text-align: center;">(Any four advantages are expected: 1/2 Mark each)</p> <ol style="list-style-type: none">1) The design and layout of Diesel electric P.P is simple.2) It requires less space.3) Time required for complete erection of diesel power plant is less.4) It can be put into service immediately.5) Such plants can be located at any place.6) The plants can be easily located nearer to load center.7) It requires less space for fuel storage.8) No waste disposal problem.9) It requires less quantity of water for cooling.10) No standby losses.11) Thermal efficiency of plant is higher than T.P.P.12) Power plant is simple in operation.13) It requires less operating & supervising staff.14) Such power plant gives quickly responses for variable load <p>Disadvantages of Diesel electric power plant:-</p> <p style="text-align: center;">(Any four disadvantages are expected: 1/2 Mark each)</p> <ol style="list-style-type: none">1) Due to production of smoke there will be air pollution.2) It produces noise from the exhaust which is a problem.3) Operating cost is high as fuel (diesel) used is costly.4) Its generating capacity is limited.5) Its overload capacity is less.6) Diesel power plant can be not supply overload continuously.7) A useful life is very short.8) Maintenance cost is high.9) The cost of lubricating oil is high.10) Availability of fuel in future may be limited.



d)	State the functions of fuel system and exhaust system of a diesel power station.
Ans:	<p><u>Fuel system:</u> (2 Marks)</p> <p>It supplies fuel to engine for combustion purpose. It consists of</p> <ul style="list-style-type: none">➤ <u>Fuel Pump:</u> - It supplies fuel to engine for combustion purpose.➤ <u>Strainer:</u> - Are provided to remove suspended impurities and to supply clean fuel to engine.➤ <u>Fuel Injector:</u> - It injects fuel in engine cylinder at the end of compression stroke.➤ <u>Heaters:</u> - Are provided to heat the coil especially during winter season <p><u>Exhaust system:</u> (2 Marks)</p> <p>This system is provided to discharge the engine exhaust (smoke) to the atmosphere outside the building. It consists of ;</p> <ul style="list-style-type: none">➤ <u>Silencer:</u> - It is provided to reduce noise.➤ <u>Muffler:</u> - It is provided to exhaust pipe to reduce pressure in exhaust line and eliminate most of the noise.➤ <u>Chimney:</u>- To exhaust gases in the atmosphere as high as possible.
e)	List and state any four limitations of inter connected power station.
Ans:	<p>Limitations of inter connected power station:-</p> <p style="text-align: right;">(Any Four limitation are expected: 1 Mark each)</p> <ol style="list-style-type: none">1) Initial cost of infrastructure of transmission line increases as length increases.2) Interconnection required more automation which increases cost on various control equipments and load center.3) Control and maintain magnitude of voltage and frequency within permissible limit of various generating station is difficult task.4) Control of reactive power is the major issue.5) Losses in transmission line increases as length of transmission line are more.6) There is possibility of cascade tripping and overall black out in large interconnected system.



- 7) Interconnection is possible only when magnitude of transmission voltage and frequency is same.
- 8) Interconnection assumes that some areas have surplus generating capacity. But in absence of surplus power merits of interconnection cannot be obtain.

f)

A generating station has the following daily load cycle.

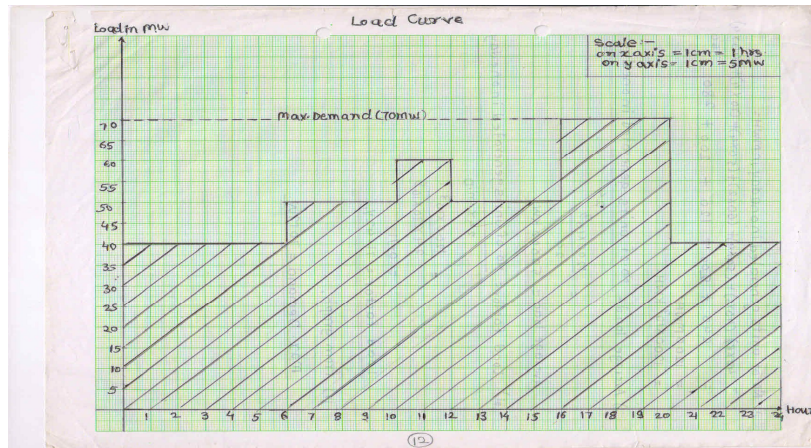
Time (hours) : 0-6 6-10 10-12 12-16 16-20 20-24

Load (MW) : 40 50 60 50 70 40

Draw the load curve and find :

- i) Maximum demand ii) Units generated per day iii) Average load and
iv) Load factor.

Ans: Load curve : (Student may take different scale to draw the graph)



(Graph 1 Mark)

i) Maximum demand : 70 MW ----- (1/2 Mark)

ii) Units generated per day :

No. of. units generated in one day in MWH =

$$= (40 \times 6) + (50 \times 4) + (60 \times 2) + (50 \times 4) + (70 \times 4) + (40 \times 4)$$

$$= 240 + 200 + 120 + 200 + 280 + 160$$

$$= 1200 \text{ MWH}$$

$$= 1200 \times 10^3 \text{ KWH} \text{ ----- (1/2 Mark)}$$



	<p>iii) Average load:</p> $\text{Average Load} = \frac{\text{No. of units generated in one day}}{24} \text{----- (1/2 Mark)}$ $\text{Average Load} = \frac{1200 \times 10^3}{24}$ $\text{Average Load} = 50000 \text{ KW} \text{----- (1/2 Mark)}$ <p>iv) Load factor:</p> $\text{Load Factor} = \frac{\text{No. of units generated in one day}}{24 \times M.D} \text{----- (1/2 Mark)}$ $\text{Load Factor} = \frac{1200 \times 10^3}{24 \times 70 \times 10^3}$ $\text{Load Factor} = 0.7142 \text{----- (1/2 Mark)}$ $\text{Load Factor} = 71.42 \%$
Q.5	Attempt any four of the following : 16 Marks
a)	"Hydro electric power station are not perennial power station". Justify.
Ans:	<p style="text-align: center;">(Note : Any relevant answer may be consider):</p> <p>Justification: (4 Mark)</p> <p>The water utilized by the hydro power plants comes mostly from storage dams/reservoirs which get filled up during the monsoon rainy season. Such reservoirs are utilized for supplying water to various purposes to: e.g.</p> <ol style="list-style-type: none">1) Water drinking storage2) Agriculture/ irrigation purpose and third purpose is generation of electricity <p>Since rainfall is depends on nature which is fluctuating/ uneven so water in reservoirs should be properly used till next monsoon season. i.e. for purpose of :</p> <ol style="list-style-type: none">1) Water drinking storage2) Agriculture/ irrigation purpose3) and not for generation of electricity <p>Because first two purposes are important. Hence "Hydro electric power stations are not perennial power station"</p>
b)	Explain the working of nuclear power plant with the help of neat sketch.
Ans:	<p style="text-align: center;">(Figure : 2 Mark & Explanation: 2 Mark)</p> <p>Working Principle of Nuclear power Station:</p> <p>In NPP, a nuclear fuel such as uranium (U^{235}), Thorium (Th^{232}) is produces heat energy during nuclear chain reaction, in a separate special apparatus known as <u>nuclear</u></p>

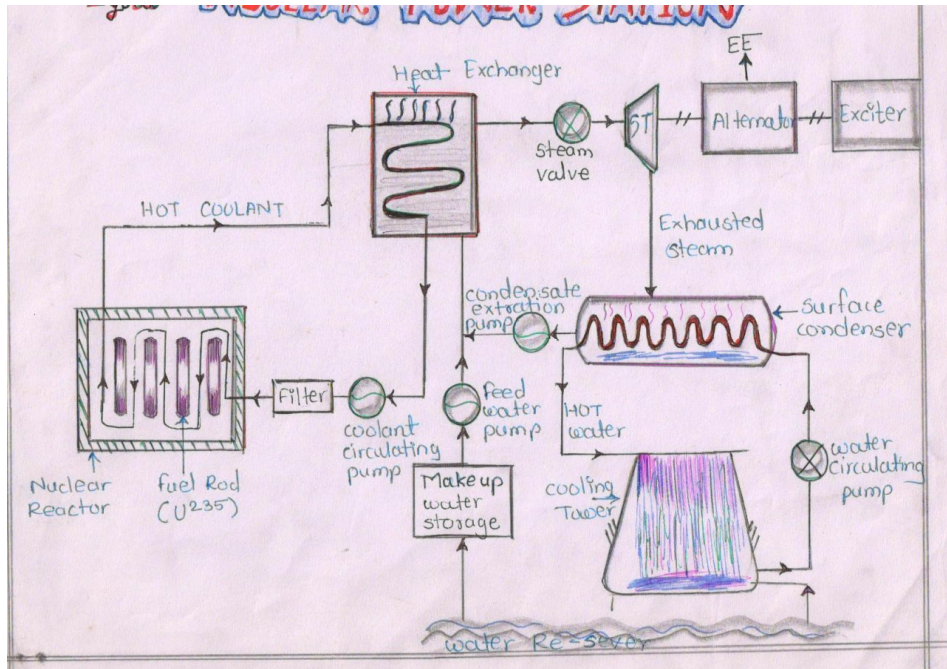


reactor.

This heat energy is utilized to produce steam at high pressure and high temperature, which is used to run the steam turbine to give mechanical power.

Alternator is mechanically coupled with steam turbine which converts mechanical energy into electrical energy.

Sketch of Nuclear power Station:



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

Ans:

1. Shielding:-

(2 Mark)

- The function of shielding is to protect environment, humans and animals from the harmful radioactive radiation (pollution) before they are emitted to atmosphere.
- Shielding is provided to absorb alpha (α), Beta (β) particles and gamma (γ) rays which are produced during nuclear chain reactions.

2. Reflector:-

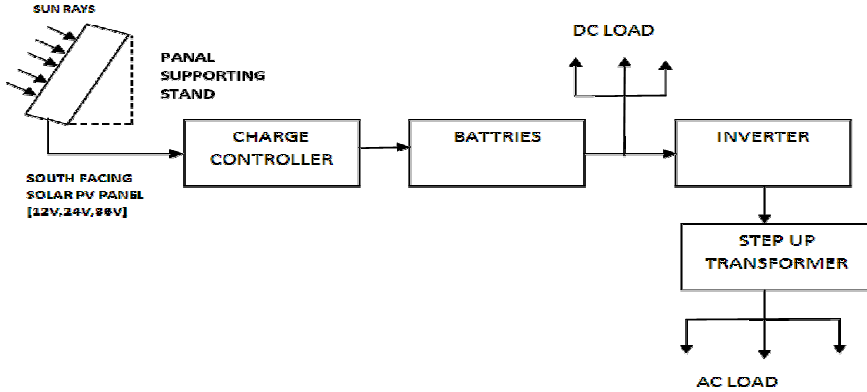
(2 Mark)

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



d)	State any four advantages of nuclear power station.
Ans:	<p>Advantages of nuclear power station :- (Any four point expected: 1 Mark each)</p> <p>1) <u>Fuel required:</u> Fuel requirement of Nuclear Power Plant is less than Thermal Power Plant. So it reduces transportation cost of fuel and space required for fuel storage.</p> <p>2) Nuclear reactor needs little fuel, once reactor is charged there is no need of fuel for 3 to 6 years.</p> <p>3) <u>Space required:</u> Nuclear power plant require less area as compared to Thermal Power Plant and HydroPower Plant of the same capacity.</p> <p>4) <u>Availability of fuel :</u> Large amount of nuclear fuel is available in nature than coal .</p> <p>5) Nuclear fuels do not produce carbon dioxide or sulfur dioxide from flue gases so it produces less air pollution than thermal power plant.</p> <p>6) <u>Quantity of waste produced:</u> Quantity of waste produced is very small as compared to Thermal Power Plant.</p> <p>7) <u>Generating capacity:</u> Nuclear Power Plant can be built of large generating capacity and is very economical for producing of bulk amount of electrical power.</p> <p>8) Nuclear energy is outstanding and reliable as compared to any other type of energy sources.</p> <p>9) <u>Load centre:</u> Nuclear Power Plant can be located near load center. As it is located near load centre it reduces transmission cost and transmission losses.</p> <p>10) Nuclear power plant are not affected by adverse weather conditions.</p> <p>11) <u>Cost of fuel :</u> In Nuclear Power Plant cost of fuel per units comes to 4-20% of total cost per unit.</p> <p>12) <u>Saves fossil fuel:</u> By use of nuclear fuel.,it saves the other fossil fuels like-coal, gas, oil, etc.</p> <hr/>



e)	With a neat block diagram state the process of converting solar energy into electric energy. Draw the diagram showing the element of such a plant.
Ans:	<p>Diagram state the process of converting solar energy into electric energy:</p> <p style="text-align: right;">(Diagram : 4Mark)</p>  <pre>graph LR; SunRays[SUN RAYS] --> Panel[SOUTH FACING SOLAR PV PANEL [12V, 24V, 36V]]; Panel --- Stand[PANAL SUPPORTING STAND]; Panel --> CC[CHARGE CONTROLLER]; CC --> BATT[BATTERIES]; BATT --> INV[INVERTER]; INV --> DC[DC LOAD]; INV --> ST[STEP UP TRANSFORMER]; ST --> AC[AC LOAD];</pre>
f)	Explain the importance of solar power in the energy deficient India.
Ans:	<p style="text-align: center;">(Note : Any relevant answer may be consider) : (4 Marks)</p> <p>Mainly electricity generated in India is from –</p> <ul style="list-style-type: none">➤ Hydro power plant➤ Thermal power plant➤ Nuclear power plant <p>BUT,</p> <p>To construct new Hydro power plant following are problem :- (Any one Point expected)</p> <ol style="list-style-type: none">1. There is limitation to select the site of HPP because of their site selection criteria.2. The building of large dams can cause serious geological damage.3. Due to construction of dam and creating large reservoir, this can force the <u>relocation</u> of large numbers of riverside cities, towns, villages & people. <p>To construct new Thermal power plant following are problem :-</p> <p style="text-align: right;">(Any one Point expected)</p> <ol style="list-style-type: none">1. It produces air pollution.2. It has lowest overall efficiency (29-47 %).3. It is more, as quantity of fuel required is more and also if power plant is located away from load center.



4. Cost per unit (cost of generation) is high

To construct new Nuclear power plant following are problem :-

(Any one Point expected)

1. The capital cost of Nuclear power plant is very high as compare to other power plant of same capacity due to reactor.
2. The fuel used is expensive and it must be stored safely.
3. Nuclear waste are redioactive and may cause dengereous amount of radioactive pollution if proper care is not taken.
4. The disposal of radioactive waste is a big problem and is hazards to health for thousands of years.
5. If there is an accident, large amounts of radioactive material could be released into the environment. Causing extensive damage to the mankind,animals and environment.
6. It is difficult to build a plant with 100% safe from radioactive radiation.
7. Generation Cost per unit is more.

Due to above reasons there is importance of solar power in the energy deficient in

India because of following advantages of solar energy:- (Any one Point expected)

1. No air pollution.
2. Solar radiation is the largest renewable resource on earth.
3. Unlimited quantity of fuel available in day time & is in exhaustible.
4. Power can be generated at the point of utilization so it reduces transmission & distribution cost and losses in it.
5. No fuel storage is required.
6. No fuel transportation cost.
7. No treatment on fuel is required.
8. No waste disposal problem.
9. It works automatically (Not required to start)
10. It saves the fossil fuel (coal, diesel, oil etc.) which are limited available.



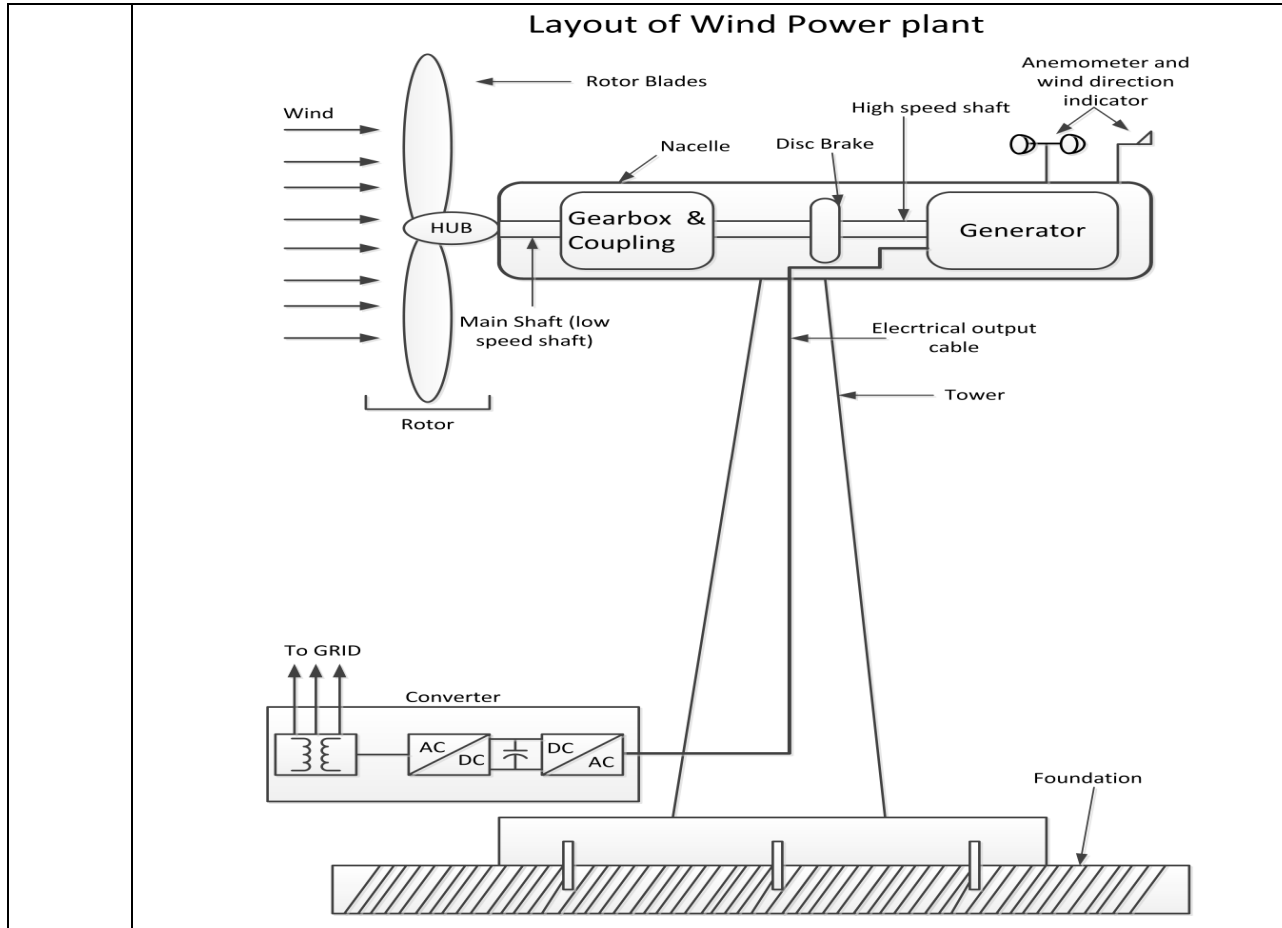
Q.6	Attempt any Four of the following :	16 Marks
a)	State the types of radioactive waste generated in a nuclear power station. Explain the methods employed for their disposal.	
Ans:	<p>➤ Types of radioactive waste: (1 Marks)</p> <p>The waste produced in nuclear power plant is in the form of solid, liquid & gases,</p> <p>1. Solid Waste Disposal:- (1 Marks)</p> <ul style="list-style-type: none">➤ 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 a tunnel, however the area must be unused land, away from populated area and there is less rain fall in that area. <p style="text-align: center;">OR</p> <ul style="list-style-type: none">➤ 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 <p>2. Liquid Waste Disposal:- (1 Marks)</p> <ul style="list-style-type: none">➤ 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 disposed off into the sea several kilometers away from sea shore. <p>3. Gaseous Waste Disposal:- (1 Marks)</p> <ul style="list-style-type: none">➤ 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)	Define :i) Maximum demand ii) Average demand iii) Plant capacity factor iv) Plant use factor.
Ans:	<p>i) Maximum Demand: (Each Definition : 1 Mark) It is the maximum load which a consumer uses at a particular time period out of his total connected load.</p> <p>ii) Average Demand :- The average of loads occurring on the power station in a given period (day or month or year) is known as Average demand.</p> <p>iii) Plant capacity factor It is the ratio of actual energy produced (generated) to the maximum possible energy that could have been produced (generated) during a given period.</p> $= \frac{\text{Actual energy generated}}{\text{Maximum possible energy (KWH) that could have been generated}}$ <p>OR $\text{Capacity factor} = \frac{\text{Average Demand}}{\text{Rated(install) plant capacity}}$</p> <p>OR $\text{Capacity factor} = \frac{\text{Total KWH (Unit) generated during a given period}}{\text{Number of hours in that period} \times \text{install capacity of plant}}$</p> <p>OR $\text{Capacity factor} = \text{Load factor} \times \text{Utilisation Factor}$</p> <p>iv) Plant use Factor:- 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.</p> <p>OR $\text{plant use factor} = \frac{\text{Station output in kWh}}{\text{Plant capacity} \times \text{hours of use}}$</p>



c)	State with a neat diagram the working of photovoltaic cell.
Ans:	<p>Figure of photovoltaic cell: (Figure : 2 Mark & Working; 2 Mark)</p> <div data-bbox="678 464 1094 716" data-label="Diagram"></div> <p>Working:-</p> <p>Solar cell operates on principle of Photo-voltaic effect</p> <p><u>Solar cell works in following steps:</u></p> <ul style="list-style-type: none">➤ The solar cell is composed of a P-type semiconductor and an N-type semiconductor.➤ When sun light (photon) is absorbed by the semiconductor material the cell produces two types, -<ul style="list-style-type: none">▪ A negatively charged electron and▪ Positively charged holes are created due to photovoltaic effect.➤ Negatively charged (-) electrons gather around the N-type semiconductor while➤ Positively charged (+) electrons gather around the P-type semiconductor.➤ When you connect loads such as a light bulb, electric current flows between the two electrodes.
d)	Draw wind power plant diagram and show main components of wind power plants.
Ans:	<p>Diagram of wind power plant : (4 Marks)</p> <div data-bbox="558 1346 1276 1864" data-label="Diagram"></div> <p style="text-align: center;">OR</p>



e) **Classify the solar collectors and compare them.**

Ans: **Classification of solar collectors :- (Classification: 1 Mark & Comparison: 3 Mark)**

1. There are two main types of Flat Plate type collectors :-

a) Flat plate collectors (FPC) b). Evacuated Tubular collector (ETC)

2. Concentrating type collectors (focusing type collector):

There are three main types of concentrating solar power system

Line Focusing: - 1) Linear cylindrical Parabolic (troughs) concentrating collector

Point Focusing: - 2) Central receiver Spherical (Dish) Parabolic concentrating Collector

3) Central receiver solar tower with number of distributed Concentrating collector

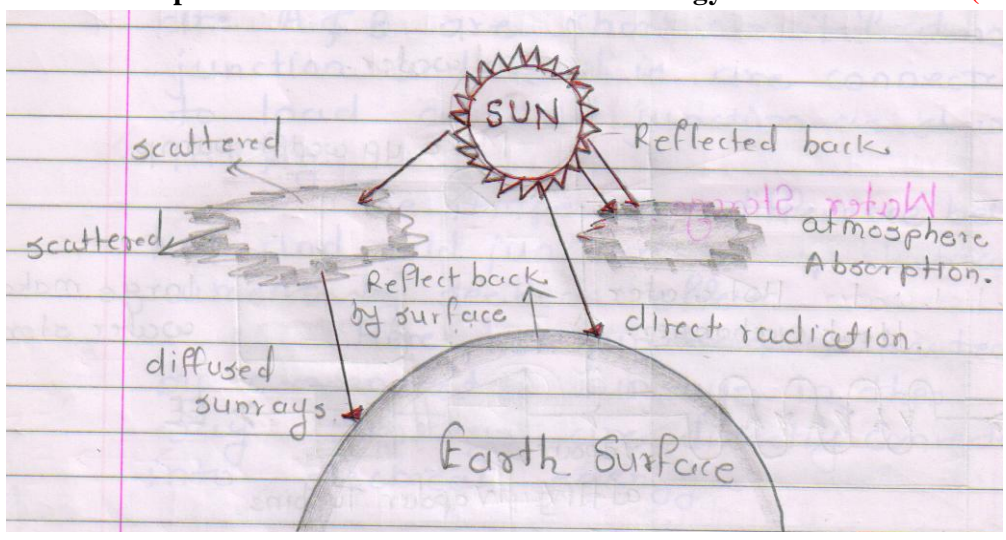


Comparison :-

(Any three Points are expected)

Sr.No.	Points	Flat plate collector	Concentrating type collector
1	Shape	Shape of collector is rectangular	Shape o collector is parabolic or disc type / Tower
2	Collector and absorber area	The Collector area is same as absorber area	The Collector/reflector area is more than absorber area
3	Design	Mechanically simple in design	Complicated in design
4	Construct	Are relatively simple to construct and erect	Difficult to construct and erect
5	Tracking	No tracking of panel is required to words sun direction	Tracking is required to words sun direction for better results
6	Uses of sun radiation	It uses both direct and diffused radiation of sun	It uses only direct radiation of sun because diffused radiation cannot be reflected.
7	Flux	Uniform flux on the collector & absorber	Non-uniform flux on the collector & absorber
8	Cloudy days	Effective even cloudy days when there is no direct radiation of sun	Ineffective in cloudy days as there is no direct radiation of sun
9	Heat losses	Heat losses are more (as absorber area is more)	Heat losses are less (as absorber area is less)
10	Efficiency	Efficiency is less	Efficiency is high
11	Temperature obtain	Temperature obtain is less (up to 90 ⁰ C)	Temperature obtain is high (up to 400 ⁰ C)
12	Heat insulation cost	Heat insulation cost is more	Heat insulation cost is less
13	Maintenance	Little maintenance	More maintenance
14	Space required	Space required is less	Space required is more
15	Anti-freeze protection	It require more anti-freeze protection	Little or no anti-freeze protection is require to protect the absorber
16	Generate steam	Not suitable to generate steam only for heating water/fluid/Air	Suitable to generate steam
17	Generate electricity	Cannot be used to generate electricity directly from water	Can be used to generate electricity with the help of steam turbine



f)	Define solar constant. Draw the schematic representation of distribution of solar energy as direct, diffused and total radiation.
Ans:	<p>Definition of Solar constant: (2 Marks)</p> <p>The rate at which solar energy arrives at the top of the atmosphere is called the solar constant.</p> <p>Schematic representation of distribution of solar energy :- (2 Marks)</p>  <p>The diagram illustrates the distribution of solar energy. At the top, a sun labeled 'SUN' emits rays. Some rays are labeled 'scattered' and 'Reflected back'. One ray is labeled 'atmosphere Absorption'. Another ray is labeled 'direct radiation' and points to the 'Earth Surface'. From the Earth's surface, one ray is labeled 'diffused sunrays' and another is labeled 'Reflect back by surface'.</p>

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