



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)	State the importance of electrical power in day today life.	----- 2 Marks									
Ans:	Importance of electrical power in day today life 1. Electrical energy is the basic necessity for domestic (residency), commercial, industrial, agriculture, consumers, transport (Electric train), and battery operated vehicle etc. 2. Electricity is also basic necessity for the economic development of a country in fact advanced country is measure by the index per capital consumption of electricity, more it is more advanced countries. e.g: We use electricity for various purposes such as: i) Lighting, heating, cooling and other domestic electrical appliances. ii) Street lighting, flood lighting, office building lighting and powering to PC's etc. iii) Irrigation purpose, operating cold storage, for various agriculture products. iv) Running motors, furnaces of various kinds in industry, running locomotives (Electric Train).										
b)	List out thermal power stations in Maharashtra and write their generating capacities.										
Ans:	(Any Two power plant name expected: 1 Mark each, Total 2 Mark)										
	<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></tbody></table>	Sr.No.	Name of Thermal Power Plant	Plant Capacity	1	Koradi	1100 MW	2	Nashik	910 MW	
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		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		
	c)	State "Spray pond" in connection with thermal power plant.				
	Ans:	Spray pond			(2 Mark)	
		<ul style="list-style-type: none">➤ Function of spray pond is to <u>reduce the temperature of water</u> coming from condenser.➤ It consists of a water tank in which hot water is distributed through number of pipes as shown in figure and is sprayed in air through nozzle at suitable pressure and is collected in pond, same water is re-circulated in condenser.				
	d)	Write the meaning of "Surface runoff" in hydro power plant.				
	Ans:	The meaning of "Surface runoff" in hydro power plant :			(2 Mark)	
		It is that portion of precipitation (rain fall) which actually flow towards stream, lake, river or ocean.				
		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.				
		Surface runoff (Run-off) = Total precipitation – total evaporation of water				
	e)	List out any two disadvantages of hydro power plant.				
	Ans:	(Any Two Disadvantages expected: 1 Mark each, Total 2 Mark)				
		Disadvantages of hydroelectric Power Stations:-				
		1. High capital cost due to construction of dam.				
		2. It takes long time for completion of power plant.				



	<ol style="list-style-type: none">3. It requires large area (catchment) area for storage of water.4. As power plant are away from load center so that the cost of transmission and losses in it are more.5. Power generation depends on nature as it require huge amount of water which is store during high flow period.6. During long dry season it affect the capacity of power generation.7. Firm power (Output) is totally depends on quantity of water available in reservoir.8. There is limitation to select the site of HPP because of their requirements so, it can be located near the load centre.
f)	Define "radioactive isotopes".
Ans:	Radioactive:- (2 Mark) Phenomenon of emitting radioactive radiation (α , β , γ) by the unstable element during fission process is known <u>as radioactive or radioactivity.</u> OR Isotopes:- Atom having same atomic number but different mass number is called isotopes. e.g. Natural Uranium occurs in 3 isotopes (${}_{92}\text{U}^{234}$, ${}_{92}\text{U}^{235}$ and ${}_{92}\text{U}^{238}$)
g)	Name any two parts of reactor and also write their functions.
Ans:	(Any Two Parts of reactor and their functions expected: 1 Mark each, Total 2 Mark) Parts of reactor and their functions 1.Core :- <ul style="list-style-type: none">➤ In which fuels (U^{235}) is kept.➤ In which heat energy is liberated by <u>nuclear chain reaction.</u> 2.Nuclear fuel (U^{235}) :- <ul style="list-style-type: none">➤ It is in the form of fuel rod.➤ It produces heat energy during <u>nuclear chain reaction.</u>➤ The nuclear fuels are U^{235}, U^{233}, Pu^{239} 3.Moderator :- <ul style="list-style-type: none">➤ The function of moderator is to moderate or reduce the speed of fast neutron.



- The material used for moderator are 1. Carbon 2. Heavy water

4. Reflector:-

- Reflector surround the reactor core and moderator.
- The function of reflector is to reflect back the neutrons which are leaving from core.
- Commonly used materials for reflectors are:- 1. Beryllium 2. Graphite

5. Bio-logical Shielding:-

- 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.
- Thick layer of lead or concrete wall are provided all over reactor core vessel for stopping (α), Beta (β) particles and gamma (γ) rays

6. Reactor vessel:-

- Its function is to surround core, fuel rod, control rod, moderator, reflector biological shielding i.e. all interior parts of reactor.
- It is strong wall container.
- It is designed to withstand at high pressure and high temperature.

7. Cladding:-

- Cladding is provided over reactor to prevent rusting and to increase life of vessel.
- Commonly used material for cladding are stainless steel and manganese.

8. Neutron detector:-

- It is a sensor which detects neutron.
- Its function is to detect how much neutrons are present in the reactor core.

9. Control rod :-

- Function of control rod is to control the chain reaction by absorbing the neutrons, in reactor core by adjusting its height.



	<p>10. Coolant:-</p> <ul style="list-style-type: none">➤ Coolant absorbs heat produced in the reactor core is then, transfer to heat exchanger for generation of steam.➤ The material used for coolant in the form of gas, liquids, liquid metal.
h)	State the meaning of "Captive power".
Ans:	The meaning of "Captive power": (2 Mark) <p>Captive power generation plant set up by <u>any person</u> OR by any <u>co-operative society</u> OR <u>association of persons</u> or <u>by industry</u> OR <u>group of industries</u> to generate electricity primarily for his own use & sell excess power to state electricity board is known as captive power generation.</p>
i)	Define "firm power".
Ans:	Firm Power: (2 Mark) <p>It is the power to be always available even during adverse condition.</p>
j)	State the meaning of interconnection of power system.
Ans:	Meaning of Interconnected (Grid) System: (2 Mark) <p>When the number of generating station, For e.g. hydro, thermal, nuclear, gas power plant etc. are interconnected through transmission line <u>and works in combination with each other</u> to supply the power continuously and economically to the consumer, This system is known as interconnected system.</p>
k)	Write all types of reactors.
Ans:	Following commercial types of reactors are used in NPP: (Any four expected: 1/2each type) <ol style="list-style-type: none">1) Advance gas cool reactor (AGR)2) Boiling water Reactor (BWR)3) Pressurized water reactor (PWR)4) Fast Breeder reactor (FBR)5) Sodium graphite reactor (SGR)6) CANDU or Heavy water cooled & moderator reactor



1)	List out any two applications of diesel power plant.
Ans:	<p>(Any Two Applications of Diesel Power Plant expected: 1 Mark each, Total 2 Mark)</p> <p>Applications of Diesel Power Plant:</p> <ol style="list-style-type: none">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.)2. It is suitable where power requirement is small.(for industrial applications)3. It is suitable as a peak load power plant for short duration.4. It is widely used in transportation system. E.g. Elect. Traction, Ship, Aero plane etc.5. Mobile DEPP mounted on vehicle is used in emergency requirement and for temporary supply purpose.6. It is used in remote places where supply from grid is not possible.7. It is very economical to supply power to small scale industry which works for seasonal period.(For short period in a year)8. The use of such plant is very common during construction stage of HPP/TPP/NPP and other construction.9. The diesel units can be used to supply the auxiliaries for starting the large thermal plants.10. Diesel plants are widely used for generating power ranging from 100 to 5,000 H.P.
Q.2	Attempt any FOUR of the following : 16 Marks
a)	List out any four renewable sources of energy and also write their future perspectives, in short.
Ans:	<p>(Any four renewable sources of energy expected: 1 Mark each, Total 4 Mark)</p> <p>Following are the some list of renewable energy sources:-</p> <ol style="list-style-type: none">1. <u>Solar Energy</u> :- Bright future perspectives, Cost also goes on reducing<ol style="list-style-type: none">i) Photovoltaic Systems (Direct conversion to electricity)ii) Solar Thermal Power plant (In direct conversion to electricity)2. <u>Wind Energy</u> :-Bright future, Cost also goes on reducing3. <u>Hydropower</u>:- Good source but limited sites available



	<p>4. <u>Ocean Energy</u> :- Good source but under research and development</p> <ul style="list-style-type: none">i) <u>Ocean Tidal Energy</u>ii) <u>Ocean Wave Energy</u>iii) <u>Ocean Thermal Energy</u> <p>5. <u>Bioenergy</u>:- Good source for rural area</p> <ul style="list-style-type: none">i) <u>Biofuels</u> (e.g. Bio-diesel, Ethanol)ii) Biomass (e.g. sugar cane bagasse, farming waste, forestry waste etc.)iii) Biogas (it is produced from any organic waste materials. It contains mixture of methane (50-65 % in volume) and carbon dioxide) <p>6. <u>Geothermal Energy</u>:- Good source but limited sites available</p> <p style="text-align: center;"><u>Geothermal Electricity Production</u></p> <p>7. <u>Fuel Cells</u>:- Good source for automobile</p>																		
b)	Distinguish between super heater and reheater in steam power plant and write their functions.																		
Ans:	(Any four points are expected : 1 Mark each point)																		
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<p>c)</p> <p>Ans:</p>	<p>Draw the flue gas flow diagram of thermal power plant and label all parts. (4 Mark)</p> <p>The flue gas flow arrangement is shown in the block diagram:</p> <p>or equivalent figure.</p> <p>OR</p> <p>d)</p>
<p>Ans:</p>	<p>Illustrate the term "hydrology" in hydro power plant and state its significance. (2Marks)</p> <p>The term "hydrology" in hydro power plant: ----- (2Marks)</p> <ul style="list-style-type: none">➤ It may be defined as the science which deals with the depletion and replenishment of water resources. <p>Significance of hydrology:- ----- (2Marks)</p> <p>To study hydrological cycle i.e. evaporation, precipitation and to estimate the yearly possible flow.</p> <ul style="list-style-type: none">➤ This study is important to select correct location of H.P.P (i.e. site selection)



e)	Explain ash disposal section in steam power plant.
Ans:	<p>Ash is disposed in a steam power plant: (4 Marks)</p> <p>➤ A large quantity of ash about 10 % produces in furnace, the removal of ash from boiler furnace is necessary for efficient combustion for this purpose ash handling unit is used.</p> <p>➤ Steps for Ash handling :-</p> <p style="padding-left: 40px;">Before handling the Ash it is desirable to quench the ash to reduce the temperature and dustyness.</p> <p>Handling of Ash includes :-</p> <ol style="list-style-type: none">1. Removal of ash from furnace2. Loading of ash on conveyers belt.3. And delivered to the space where it can be disposed off. <p><u>The various methods for the disposal of ash are as follows</u></p> <ol style="list-style-type: none">1. Hydraulic system.2. Water Jetting3. Pnumetic system4. Mechanical ash handling system.
f)	Write any four merits of steam power plant.
Ans:	<p style="text-align: right;">(Any four merits are expected: 1 Mark each, Total 4 Mark)</p> <p><u>Merits of steam power plant -</u></p> <ol style="list-style-type: none">1. Cost of fuel:- Fuel used in thermal power station (TPS) is cheaper than cost of fuel used in diesel & nuclear power station.2. Capital cost:- Capital cost of TPS is less than hydro & nuclear power station.3. Near load center:- TPS can be located near load center. The coal can be transport from coal mines to power plant. As it is located near load centre it reduces transmission cost and losses in it.



	<p>4. Space required:- Less space required as compared to hydro power station.</p> <p>5. Generating capacity:- TPP can be build/construct of high generating capacity, so used as a base load power plant</p> <p>6. Overload capacity:- Steam engines and turbine can work under 25% overloads continuously.</p> <p>7. Time required for completion of project:- Time required for completion of TPP project is very less as compare to hydro power station.</p>
Q.3	Attempt any FOUR of the following : 16 Marks
a)	Discuss any four factors necessary for selection of hydro power plant site.
Ans:	<p style="text-align: center;">(Any four points are expected: 1 Mark each, Total 4 Mark)</p> <p>Following Factors necessary for selection of hydro power plant site.</p> <ol style="list-style-type: none">1. HPP should be located where high rain fall occurs.2. A large catchments area must be available to store water (to store water reservoir)3. It should be located as per possible in hilly area to reduces construction cost of dam and water reservoir.4. Store water have a reasonable head (Potential Energy).5. The catchment area should be such that there are less accumulation of silt and debris.6. Large quantity land should be available for water reservoir.7. It should be located as far as possible near load center to reduce transmission line cost and losses in it.8. Easy access towards the site.9. Cost of land should be less.10. Solid (Land) should of high bearing capacity to reduce the construction cost of damp and other structure also to make strong foundation to machinery.11. Skilled and unskilled man power should be available near the HPP.



	<p>12. The Area should be free from earthquake.</p> <p>13. During the construction of dam, it should be possible to divert the stream (river)</p> <p>14. It is necessary to see that water is of good quality (i.e.no chemical impurities) because polluted water make cause corrosion</p> <p>15. Structures of cultural or historical importance should not be damaged.</p>
<p>b)</p>	<p>Draw the schematic diagram of advanced gas cooled reactor and label all parts.</p>
<p>Ans:</p>	<p>the schematic diagram of advanced gas cooled reactor and label all parts: (4 Mark)</p> <p>The diagram is a hand-drawn schematic of an advanced gas-cooled reactor. It features a central 'Reactor Vessel' containing 'Moderator' and 'Fuel Rod' elements. A primary loop of 'Hot coolant (Helium / CO₂)' circulates from the reactor vessel to a 'Heat exchanger'. From the heat exchanger, the coolant goes to a 'Steam generator' where 'steam at high pressure & high temperature' is produced. The steam generator is connected to a 'Water In.' source. The secondary loop of the steam generator is connected to a 'Coolant circulating pump' which includes a 'Filter'. The pump returns the coolant to the reactor vessel.</p>
<p>c)</p>	<p>Discuss the engine starting system in diesel power plant with neat diagram.</p>
<p>Ans:</p>	<p>(Names of starting systems – 2 Marks , Diagram – 2 Mark)</p> <p>Engine Starting system:</p> <ul style="list-style-type: none">➤ Air compressor Air reservoir for large capacity engine➤ Battery operated electrical motor➤ For small engine it is started manually by handle <p>OR</p> <p>Engine Starting procedure:</p> <p>Before Starting diesel engine it is desirable to check.</p>

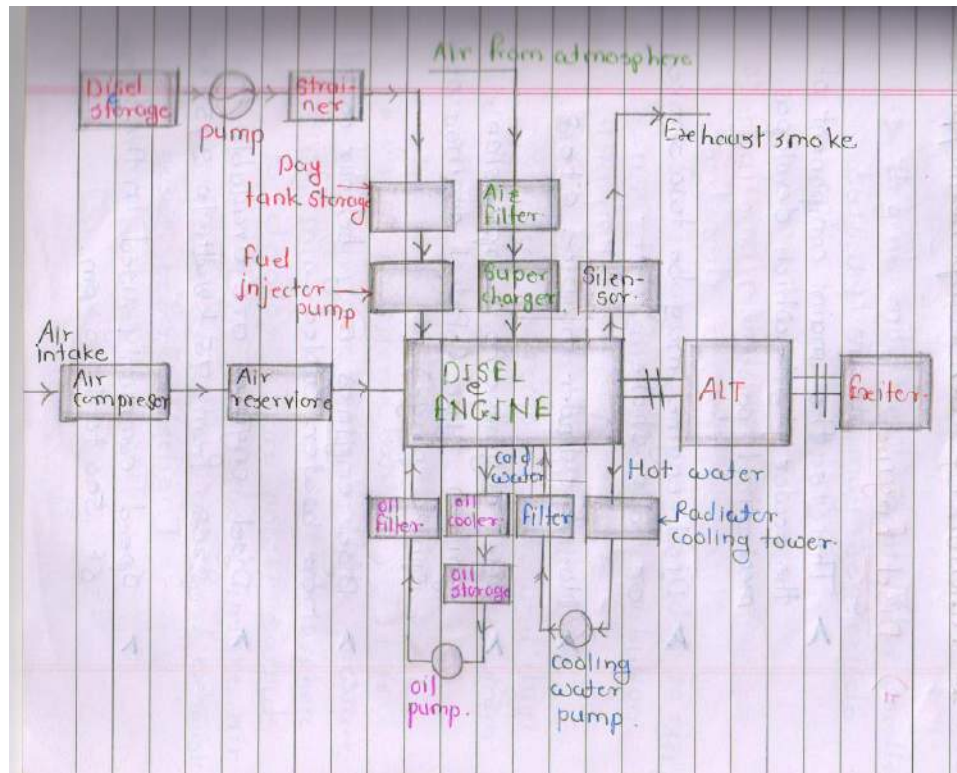


- Fuel available.
- Lubricating oil level.
- Coolant level (In some types Water cooling system)
- If it is started by compressed air then pressure of air should be checked.
- After checking diesel engine it is started on no load.
- The speed of the engine should gradually increase till we get rated voltage and frequency value.
- After that load on alternator are step by step increases up to its full load.

Diagram:



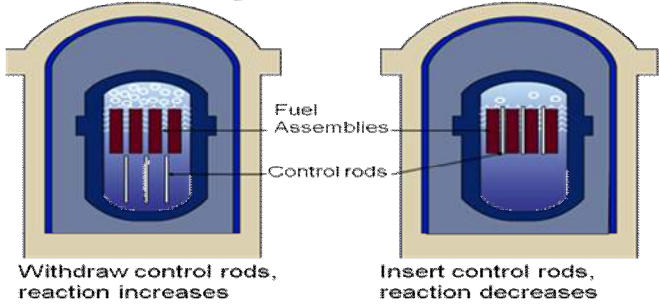
OR





d)	Explain turbo alternator in steam power plant.
Ans:	<p><u>Explanation Turbo alternator:</u> (4 Mark)</p> <p>An alternator is an electromechanical device.</p> <ul style="list-style-type: none">➤ Its function is to convert mechanical energy (power) into electrical energy (power). <p>Special Features (Highlights): (Any four points are expected)</p> <ul style="list-style-type: none">➤ It is 3-ph alternator.➤ It is robust in construction.➤ A separate excitation is given to separate alternator pole by DC generator (Exciter) which is mounted on same shaft.➤ Generated voltage is 3.3KV, 6.6Kv, 11KV, 17.5KV and 20 KV.<ul style="list-style-type: none">➤ Number of poles 2 or 4: Its synchronous speed is 3000 rpm for two pole and 1500 rpm to 4 poles to get 50 Hz supply frequency➤ They are smaller in diameter and of long axial length (diameter maximum 1 meter for 2 pole alternator)➤ Cooling system: for small rating alternators up to 40 MW. Stator and rotor is air cooled.➤ For high rating alternator up to 150 MW, it is hydrogen cooled Above 150 MW hollow stator conductors is used through which coolant is circulated cooling purpose. Cooling is necessary to improve the performance of alternator.➤ Standard rating of turbo alternator are 125,200,250,300,500 MW maximum rating of turbo alternator is 500 MW.➤ Protection :<ol style="list-style-type: none">1. Protection against run away (high speed) speeds are provided2. over voltage under voltage protection,3. over load protection4. over & under frequency protection,5. Over temperature protection are main protections provided to alternator➤ Power factor is 0.8 lagging,➤ Better in dynamic balancing



e)	<p>Compare prime movers used in hydro power plant with respect to their construction, speed, capacity and head available.</p>																																													
Ans:	<p style="text-align: right;">(Each Point: 1 Mark)</p> <table border="1" data-bbox="358 510 1304 758"> <thead> <tr> <th>S.No</th> <th>Points</th> <th>Impulse turbine</th> <th>Reaction turbine</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Construction</td> <td>Small</td> <td>Large</td> </tr> <tr> <td>2</td> <td>Speed</td> <td>High</td> <td>Low</td> </tr> <tr> <td>3</td> <td>Capacity</td> <td>High</td> <td>Medium & low</td> </tr> <tr> <td>4</td> <td>Head available</td> <td>High head</td> <td>Medium & low head</td> </tr> </tbody> </table> <p style="text-align: center;">OR</p> <table border="1" data-bbox="358 858 1427 1125"> <thead> <tr> <th>S.No</th> <th>Points</th> <th>Pelton turbine</th> <th>Francis turbine</th> <th>Kaplan turbine</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Construction</td> <td>Small</td> <td>large</td> <td>Less</td> </tr> <tr> <td>2</td> <td>Speed</td> <td>High</td> <td>Low</td> <td>High</td> </tr> <tr> <td>3</td> <td>Capacity</td> <td>High</td> <td>High</td> <td>Medium & low</td> </tr> <tr> <td>4</td> <td>Head available</td> <td>High head</td> <td>Medium and High head</td> <td>Low head</td> </tr> </tbody> </table>	S.No	Points	Impulse turbine	Reaction turbine	1	Construction	Small	Large	2	Speed	High	Low	3	Capacity	High	Medium & low	4	Head available	High head	Medium & low head	S.No	Points	Pelton turbine	Francis turbine	Kaplan turbine	1	Construction	Small	large	Less	2	Speed	High	Low	High	3	Capacity	High	High	Medium & low	4	Head available	High head	Medium and High head	Low head
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Ans:	<p>The control of nuclear reactors by using control rods:</p> <p style="text-align: right;">(Explanation: 3 Marks & Figure: 1 Mark)</p> <p style="text-align: center;">Controlling the Chain Reaction</p>  <ul style="list-style-type: none"> ➤ Control rods are made up of very high neutron absorbing material like boron, cadmium. ➤ By adjusting height of control rods in reactor core (according to requirements) we can control the chain reaction. ➤ When control rods are pushed <u>in deep in core</u>. 																																													



	<p>Then control rod is absorbing almost all neutrons in the fission process. Hence chain reaction will stop automatically.</p> <p>➤ When control rods are being <u>withdrawn from the reactor core, (are pulled up)</u> Then more and more neutrons are available. Hence intensity of chain reaction (heat produced) will increase.</p> <p>Therefore by putting out of control rods <u>from core</u> power of nuclear reaction will increase. Whereas by pushing control rod <u>in core</u> it will reduce.</p>
Q.4	Attempt any FOUR of the following : 16 Marks
a)	State the advantages of hydro power plant.
Ans:	Advantages of Hydroelectric power plant:- (Any four advantages are expected: 1 Mark each) <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. (like Pulversation of coal and enriched uranium)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 fuel (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. They have a life period of 100–125 years.17. In addition to generation of electric energy H.P.P. is also useful for supply of



	<p>drinking water, supply of water for irrigation purpose and it control the flood also.</p> <p>18. Since, hydroelectric stations are situated far away from populated areas so, the cost of the land is low.</p> <p>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.</p> <p>20. It is very neat & clean plant.</p>
<p>b)</p>	<p>Explain the use of diesel power plant as captive power.</p>
<p>Ans:</p>	<p>(Any four points expected 1 Mark each point)</p> <p>Diesel power plant is used as a captive power plant because :-</p> <ol style="list-style-type: none">1. It can be put into service immediately.2. Such power plant quickly responses for variable load3. The design and layout of Diesel electric P.P is simple.4. It requires less space.5. Time required for complete erection of diesel power plant is less.6. Such plants can be located at any place.7. It requires less space for fuel storage.8. It is free from ash handling problem.9. It requires less quantity of water for cooling.10. No standby losses.
<p>c)</p>	<p>Explain load duration curve with neat diagram.</p>
<p>Ans:</p>	<p>Diagram of load duration curve: (Figure : 2 Mark & Explanation: 2 Mark)</p> <div style="display: flex; justify-content: space-around;"><div data-bbox="344 1524 878 1919"><p>The diagram shows a step-down function representing load over time. The vertical axis is labeled 'load, MW' and the horizontal axis is labeled 'Time (hours)'. The time axis is divided into four intervals: T₁, T₂, T₃, and T₄. The load is highest in T₁ and decreases in steps through T₂, T₃, and T₄.</p></div><div data-bbox="922 1539 1425 1919"><p>The graph is titled 'Cumulative Load Duration Curve'. The vertical axis is 'Percent of Peak Load' (0 to 100) and the horizontal axis is 'Cumulative Hours' (0 to 8,500). The area under the curve is divided into three regions: 'Peak Load Plants' (top, blue), 'Intermediate Load Plants' (middle, yellow), and 'Base Load Plants' (bottom, orange). The 'Base Load Plants' region is also labeled 'Capacity (MW) * NCF'.</p></div></div> <p style="text-align: center;">OR</p>



Explanation of load duration curve:

It is drawn from load curve. It is graph of load (MW/KW) arranged in descending order of magnitude with respect to time.

Descending means maximum load is on extreme left while minimum towards extreme right as shown in graph above.

It can be drawn from zero hours to 8760 hours is called annual load duration curve.

Importance of load duration curve:

Following information is obtained from load duration curve:

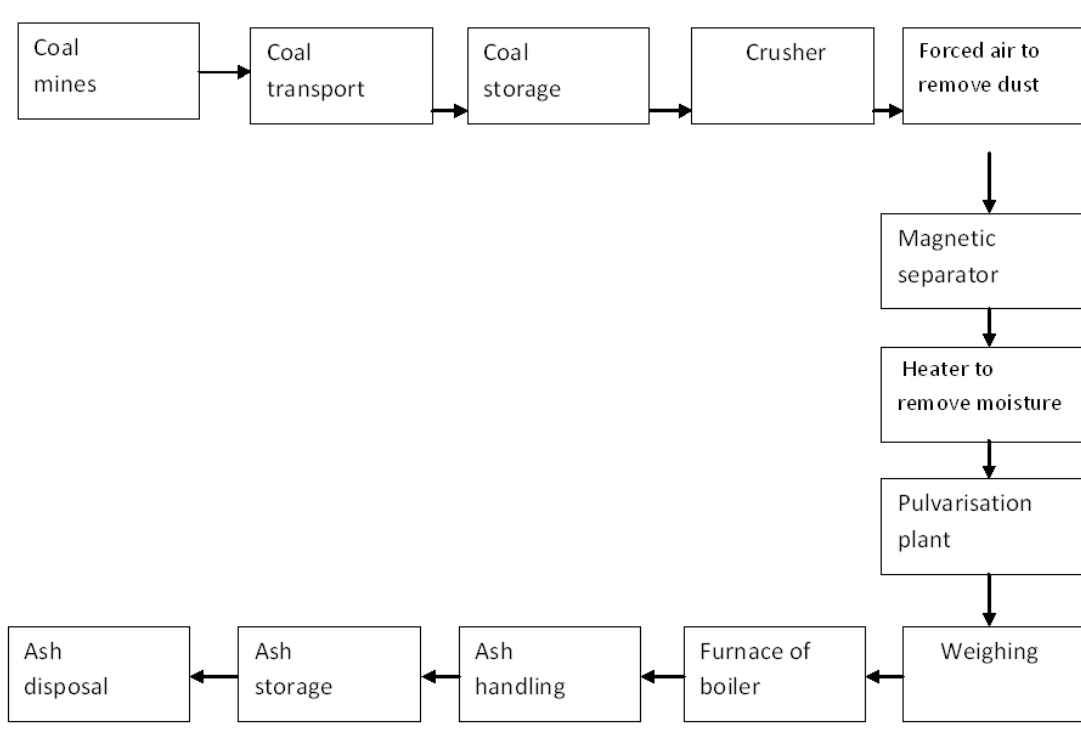
- It shows for how long hours a particular load exists.
- It helps to determine distribution of load between different generating set.
- The area of load duration curve is equal to that corresponding load curve. So area under this curve also gives number of units generated

d) Show with the help of schematic diagram coal handling unit in steam power plant.

Ans:

Schematic diagram coal handling unit in steam power plant:

(4 Mark)





e)	State the types of captive power plants and explain in brief.
Ans:	<p>The types of captive power plants: (Types : 3 Mark & any one explanation expected: 1 Mark)</p> <ol style="list-style-type: none">1. Wind power plant2. Solar power plant3. Diesel power plant4. Thermal power plant5. Gas power plant <p>Explanation:</p> <p>1. Wind power plant:-</p> <p>The power plant in which wind energy is used to generate electrical energy is known as wind power plant.</p> <p>Principal of Wind Power plant:</p> <p>The power plant in which kinetic energy of wind is used to run aero-turbine to give mechanical energy, Turbine is coupled with alternator which converts mechanical energy into electrical energy.</p> <p>2. Solar power plant :-</p> <p>The power plant in which solar energy from sunrays are converted into electrical energy directly or indirectly is known as ‘Solar power plant’</p> <p>3. Diesel power plant :-</p> <p>Definition:</p> <p>Diesel electric power plant is the power plant in which diesel engine used as a prime mover coupled with alternator for generation electrical energy.</p> <p>Diesel engine gives mechanical power which is used to drive alternator to produce electrical energy. Alternator is directly coupled to diesel engine</p> <p>4. Thermal power plant :-</p> <p>A generating station which converts heat energy (<i>Combustion is a rapid chemical reaction between Fuel and oxygen</i>) into electrical energy is known as thermal power</p>



	station or thermal power plant or steam power station. 5. Gas power plant :- Gas power plant is a power station which burns fuel natural gas to produce electricity.
f)	Classify different condensers used in steam power plant and write their functions.
Ans:	Classify condensers used in steam power plant: (2 Mark) 1) Jet Condenser (Mixing type) 2) Surface condenser (non mixing type) Function of condenser types: Steam is again converted in to water (2 Mark) 1. Jet Condenser (Mixing Type) :- In Jet condenser the steam and cold water comes in direct conduct with each other. Therefore it cannot be used as feed water. 2. Surface condenser (non Mixing type):- ➤ In surface condenser cold water is passed through pipes and steam is passed over these pipes. so there in no direct contact between the steam and cooling water. Due to cold water steam is again converted into water called as condensate. ➤ This condensate is reused in boiler. This type of condenser is used for high capacity thermal power plant.
Q.5	Attempt any four of the following : 16 Marks
a)	Explain the procedure of disposal of nuclear waste in short.
Ans:	(Solid Waste Disposal- 2 Mark, Liquid Waste Disposal: 1 Mark & Gaseous Waste Disposal- 1 Mark) The procedure of disposal of nuclear waste: ➤ <u>Nuclear waste disposal in nuclear power station:</u> 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 is not carefully disposed off. ➤ <u>Solid Waste Disposal:-</u> ➤ Solid wastes removed from the reactor are very hot and radioactive.



	<ul style="list-style-type: none">➤ 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. <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. <p style="text-align: center;">OR</p> <ul style="list-style-type: none">➤ Many times old and unused coal mines, salt mines, can be used for waste disposal <ul style="list-style-type: none">➤ <u>Liquid Waste Disposal:-</u><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 disposal off into the sea several kilometers away from sea shore.➤ <u>Gaseous Waste Disposal:-</u><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)	State the principle of solar cell and give its ratings.
Ans:	<u>Principle of Solar Cell:-</u> (Principle : 2 Mark & its rating : 2 Marks) <p style="text-align: center;">Solar cell operates on principle of Photo-voltaic effect</p> <p><u>Solar cell works in following steps:</u></p>

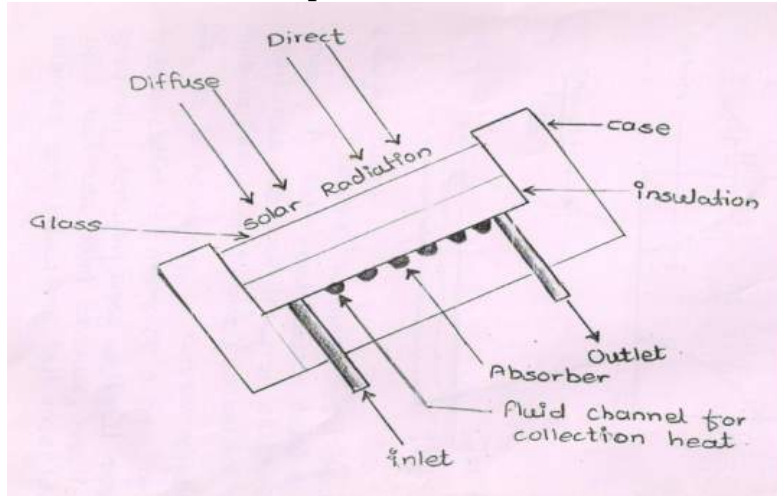


	<ul style="list-style-type: none">➤ The solar cell is composed of a P-type semiconductor and an N-type semiconductor.➤ When sun light (photon) is absorbed by the semiconductor material the cell produces two types, -<ul style="list-style-type: none">▪ A negatively charged electron and▪ Positively charged 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 <p><u>Rating of Solar Cell:</u></p> <ul style="list-style-type: none">➤ Each solar cell generates = 0.5 to 1V DC➤ And Current density = 20 to 40A /mm² i.e. 0.8 Amp
c)	Classify solar collectors and draw constructional diagram of any one collector.
Ans:	<p>(Types: 3 Mark & any one constructional diagram: 1 Mark , Total : 4 Mark)</p> <p><u>Solar of Collectors are of two types:</u></p> <p>1. There are two main types of Flat Plate type collectors :-</p> <p>a) Flat plate collectors (FPC) b). Evacuated Tubular collector (ETC)</p> <p>2. Concentrating type collectors (focusing type collector):</p> <p>There are three main types of concentrating solar power system</p> <p><u>Line Focusing:</u> - 1) Linear cylindrical Parabolic (troughs) concentrating collector</p> <p><u>Point Focusing:</u> - 2) Central receiver Spherical (Dish) Parabolic concentrating Collector</p> <p>3) Central receiver solar tower with number of distributed Concentrating collector</p>



Constructional diagram :-

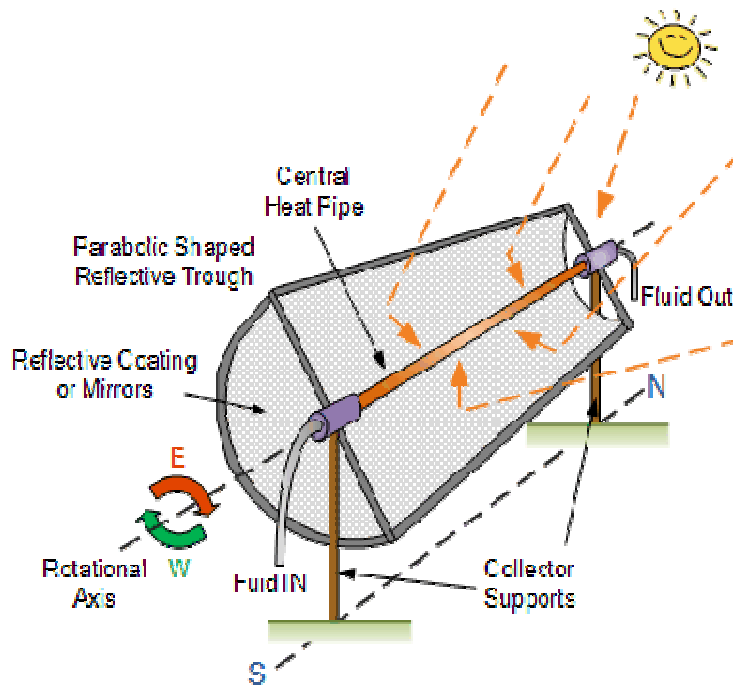
1. Schematic view of Flat plate collector:



or equivalent figure

OR

2) Line focusing concentrating type collector:

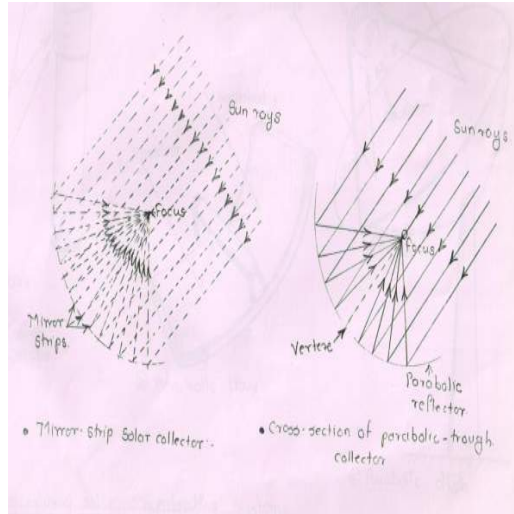


or equivalent figure

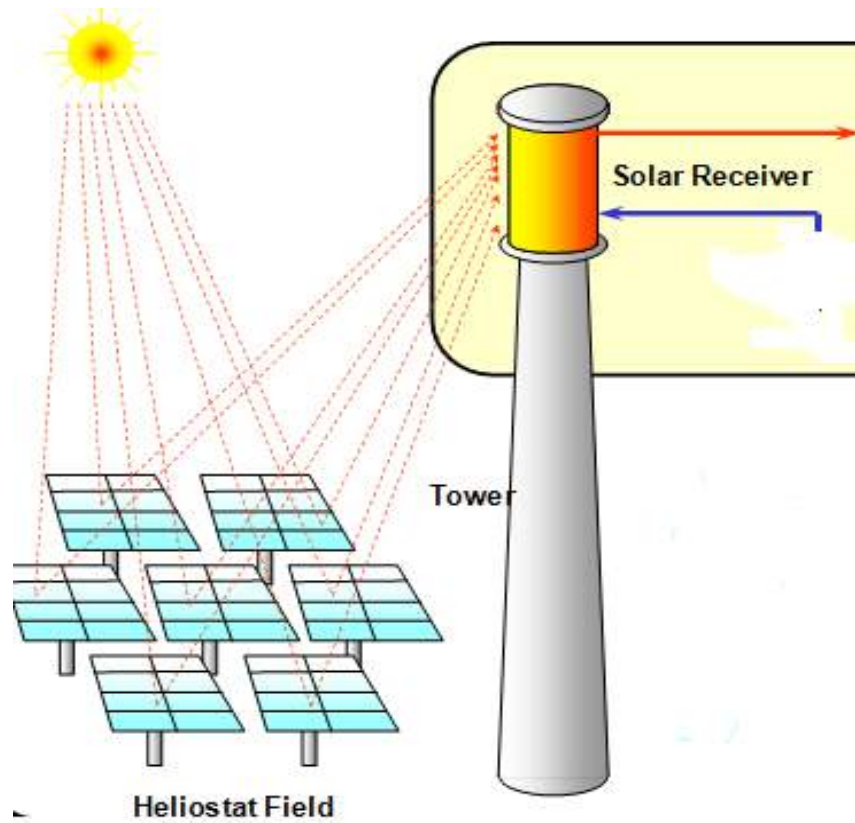
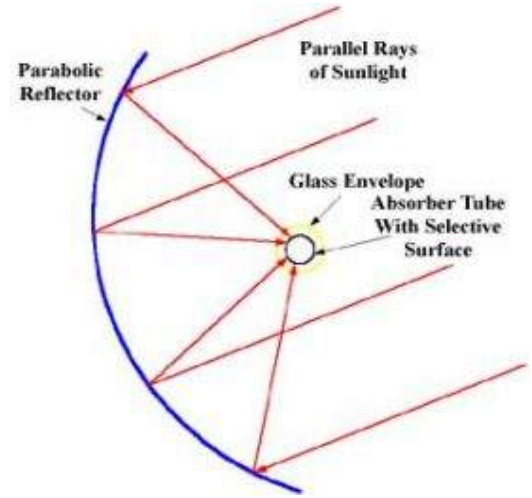
OR



3) Point focusing concentrating type collector (Parabola):



OR



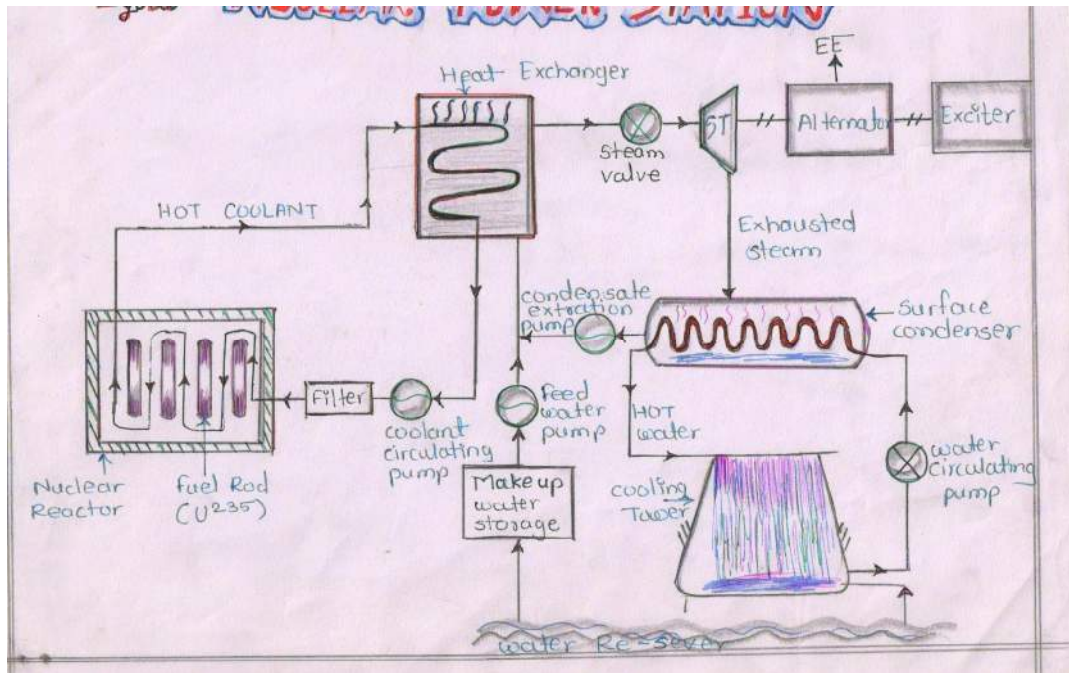
Point focusing concentrating type collector (Tower)



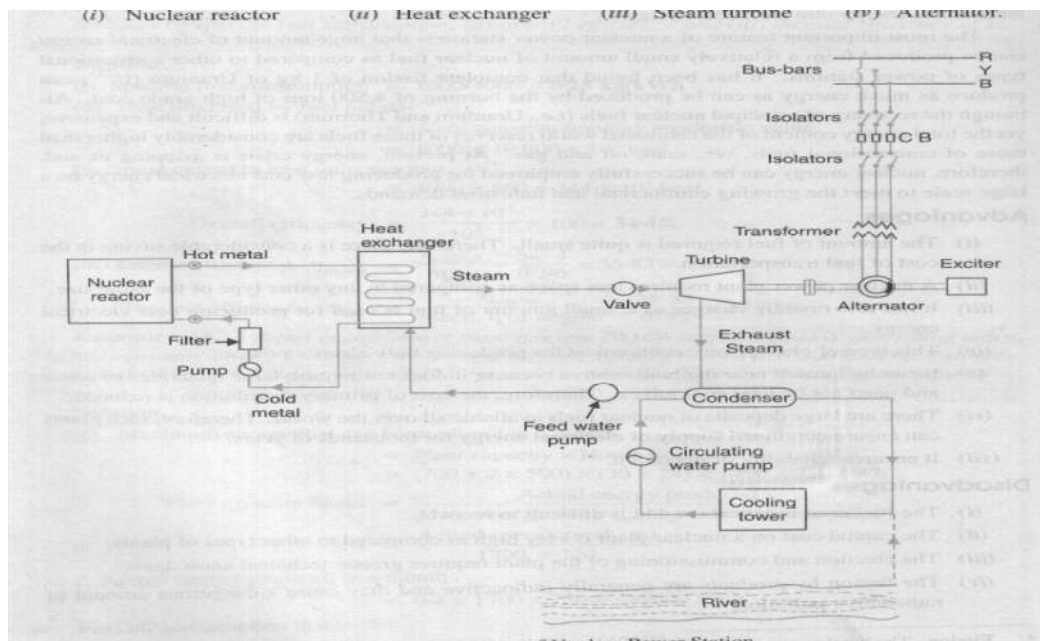
d) Show the schematic arrangement of a typical nuclear power plant.

Ans: Schematic arrangement of a typical nuclear power plant:

(Diagram:4 Mark)



OR



OR Equivalent Figure



e)	Classify hydro power plant on the basis of load and head available.
Ans:	Classify hydro power plant on the basis of Load supply : (2 Mark) <ol style="list-style-type: none">1. Base load Power plant2. Peak load power plant3. Pumped storage for peak load plant <u>Classify hydro power plant on the basis of Head of Water: (2Mark)</u> <ol style="list-style-type: none">1. Very high head power plant2. High head power plant3. Medium head power plant4. Low head power plant
f)	State the factors due to which the location of nuclear power plant site nearer the load centers becomes difficult.
Ans:	The factors due to which the location of nuclear power plant site nearer the load centers becomes difficult: (Any four factor expected : 1 Mark each) <ol style="list-style-type: none">1) <u>Availability of water:</u> The power plant should be located near sea shore, ocean, lake, river etc. as it required large amount water.2) <u>Away from populated area:</u> As far as possible power plant should be located away from populated area from the safety point of view.3) <u>Distance from load centre :</u> Power Plant should be located near load centre to reduce transmission cost & transmission Losses.4) <u>Easy Access:</u> There should be easy acces towards site of power plant for transfortation of machinery, man power, fuel etc.5) <u>Waste disposal (Availability of space for disposal of waste):</u> Sufficient land should be available for power plant for short storage of radioactive waste and also for future expansion.

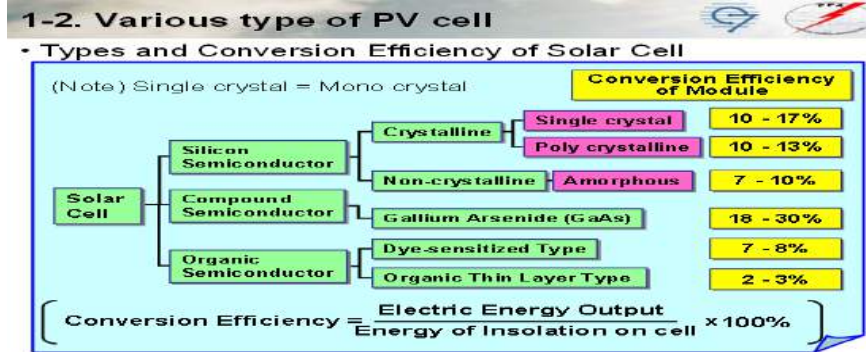


	<p>6) <u>Type of land (Soil):-</u> Land should be of good bearing (hard) capacity to reduce construction cost of power plant and for better foundation of equipment and machinery.</p> <p>7) <u>Cost of land:</u> To reduce capital cost of power plant, cost of land should be less.</p> <p>9) <u>Area free from earth quakes:</u> Area should be free from earthquake and natural hazards from the safety point of view of power plant.</p> <p style="text-align: center;"><u>OR</u></p> <p>The factors due to which the location of nuclear power plant site nearer the load centers becomes difficult:</p> <ol style="list-style-type: none">1. It should be located near a sea or river/Lake side.2. It should be located away from the populated area.3. It should be located near load centre.4. There should be easy access towards power plant.5. There should be adequate space & arrangement for short time storage of the radioactive waste.6. Cost of land should be less.7. Soil of the land should be of good bearing capacity.8. Area should be free from earthquake.	
Q.6	Attempt any Four of the following :	16 Marks
a)	List types of solar cells with their efficiencies.	
Ans:	<p><u>Types of solar Solar cells:</u></p> <ol style="list-style-type: none">1. P-N Homo-junction.2. P-N Hetro Junction3. Hetro Junction –Homo Junction4. MIS (Metal Insulator semiconductor)5. SIS (Semiconductor insulator semiconductor) <p>Efficiencies of a solar cell:-</p>	<p>(Types:2 Mark each)</p> <p>(2 Mark)</p>



The efficiency of a solar cell is the ratio of the electrical output power to the input power of the striking sunlight radiation. **Efficiency upto 20%**

OR



b) Distinguish between base and peak load.

Ans:

(Any four points expected : 1 Mark each)

Sr.No.	Base load	Peak load
1	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 of such power plant is high	Generating capacity of such power plant is medium or low
3	Firm generating capacity of such power plant is High	Firm generating capacity of such power plant is low
4	Such power plant working hours is 24 hours	Such power plant working hours are only during peak load hours
5	Load factor of such power plant is high	Load factor of such power plant is low
6	Utilization factor of such power plant is more.	Utilization factor of such power plant is less.
7	Generally low cost of generation per unit are selected as base load plant	Generally high cost of generation per unit are selected as peak load plant
8	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
9	Large capacity hydro, thermal, nuclear power station	Small capacity storage hydro, pumped storage hydro, gas, diesel power station.



c)	Draw the block diagram showing basic wind energy conversion system and write function of each block.
Ans:	<p>Block diagram showing basic wind energy conversion system:</p> <p style="text-align: right;">(Figure : 3 Mark & Function : 1 Mark)</p> <pre>graph LR; WIND --> WT[WIND TURBINE]; WT --> GC[GEARING AND COUPLING]; GC --> EG[ELECTRICAL GENERATOR]; EG --> LOAD[TO LOAD UTILITY GRID]; WT -- SPEED --> CONTROLLER[CONTROLLER]; CONTROLLER -- CONTROL SIGNAL --> WT; CONTROLLER -- CONTROL SIGNAL --> GC; EG -- GEN. TEMP. --> CONTROLLER;</pre> <p style="text-align: center;">OR</p> <p style="text-align: center;">Layout of Wind Power plant</p>



Function of each block :

1. Rotor /Blade/Aero-turbine:-

- Blades extract power from the wind, so it converts kinetic energy of wind into mechanical energy.

2. Hub:-

- Hub connect rotor of the wind turbine to the main shaft.(Low speed shaft)

3. Main Shaft (Low speed shaft):-

- Its function is to:-
 - To support the weight of rotor.
 - It transfers mechanical energy to the rest of the drive train.

4. Gear box:-

- Speed of wind turbine is low the function of gearing arrangement is to increase speed of shaft to the level as per design

5. High speed shaft:-

- Its function is to transfer mechanical energy from gear box to generator.

6. Coupling:-

Coupling are used to connect shaft together

- Between main shaft and gear box
- Between gear box output and the generator.

7. Break:-

- Its function is to stop the wind turbine whenever necessary.

8. Yaw Controller:-

- Wind constantly changes direction so it is necessary to turn the rotor blade towards face of wind to maximize energy captured from wind.

9) Furling:-

- Furling is turning the rotor out of the wind.
- Its function is :
 - To protect turbine from Over-speed.

10. Pitch Controller:-



	<ul style="list-style-type: none">• The function of the pitch controller is to adjust automatically the pitch of each blade according to wind velocity. <p>11. <u>Electrical Generator:-</u></p> <ul style="list-style-type: none">• Function of generator is to convert mechanical energy into electrical energy.• Generator may be AC or DC. <p>12. <u>Anemometer:-</u></p> <ul style="list-style-type: none">• It measures the velocity of wind and signal to the controller. <p>13. <u>Controller:-</u></p> <ul style="list-style-type: none">• Function of controller is to run the wind turbine in safe mode condition. <p>14. <u>Nacelle:-</u></p> <ul style="list-style-type: none">• The nacelle is the housing for the principle components of the wind turbine.• Its function is to protect, to the principle components of the wind turbine from weather or atmospheric condition. <p>15. <u>Tower:-</u></p> <ul style="list-style-type: none">• Towers are supports to the wind turbine.
d)	Identify any two advantages and any two disadvantages of nuclear power plant.
Ans:	Advantages of nuclear power plant: (Any Two advantages Expected : 1 Mark each) 1) <u>Fuel required:</u> The amount of nuclear fuel required is quit small. So it reduces transportation cost of fuel and space required for fuel storage. (U^{235} can produce as much energy that can produce by the burning of 2500/3000/4500 tones of high grad coal depending upon quality (calorific value) of fuel.) 2) Also nuclear reactor needs little fuel once reactor is charged there is no need of fuel for 3 to 6 years. 3) <u>Space required:</u> Nuclear power plant require less area as compared to thermal power plant and hydro power plant of the same capacity. (as less auxiliaries are required hence small space required.) (e.g. 2000 MW NPP needs about 80 acres land whereas for TPP 250 acres top land



4) Availability of fuel :

Large amount of nuclear fuel is available in nature . (*NPP is the only alternative source which can meet the future power demand of the world.*)

5) Saves fossils fuel:

By use of nuclear fuel It saves the other fossil fuels like-coal, gas, oil, etc.

6) Nuclear fuels do not produce carbon dioxide or sulfur dioxide so it produces less air pollution than thermal power plant. (*It does not contribute to global warming*)

7) Quantity of waste produced:

Amount of waste produced is very small in quantity as compared to TPP.

8) Economical:

This type of plant is very economical for producing bulk amount of electric power

9) Nuclear power plant are not affected by adverse weather conditions.

10) Nuclear energy is outstanding as compared to any other type of energy sources.

11) Nuclear power plant is reliable in operation.

12) Load centre:

NPP can be located near load center. As it is located near load centre it reduces transmission cost and losses in it.(e.g. Nuclear power plant at Tarapur is located near Mumbai.)

13) Cost of fuel :

In NPP cost of fuel per unit comes to 4-20% of total cost per unit.

Where as the cost of fuel in TPP comes about 40% of total cost per unit.

Disadvantages: of nuclear power plant :

(Any Two disadvantages Expected : 1 Mark each)

1. The capital cost of Nuclear power plant is very high as compared to other power plant of same capacity.
2. The erection & commissioning of plant require greater technical knowledge so it increases cost.
3. Specially trained staff is required to handle the plant.i.e. it requires high skill



	<p>technician</p> <p>which rises the running cost due to high salaries.</p> <p>4. The fuel used is expensive. and <u>It must be stored safely</u></p> <p>5. The fission(nuclear chain reaction) products are redioactive and may cause dengereous amount of radioactive pollution if proper care is not taken.</p> <p>6. It is difficult to build a plant with 100% safe from radioactive radiation.</p> <p>7. The disposal of radioactive waste is a big problem and is harazards to health for thousands of years.</p> <p>8. Disposal of nuclear waste require high cost.</p> <p>9. Nuclear power plant not suitable for variable load. (<i>As reactor can not be easily controlled</i>)</p> <p>10. Generation Cost per unit is more, because of additional expenses like security.</p> <p>11. The cooling water requirements of NPP are very heavy.</p> <p>12. Cooling towers required for NPP are larger & costlier than TPP.</p> <p>13. Time required for erection is more.</p> <p>14. 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</p>
e)	<p>A generating station has a connected load of 43 MW and maximum demand of 20 MW. The units generated are 61.5×10^6 per year. Calculate: i) Demand factor and ii) Load factor.</p>
Ans:	<p>Given Data:</p> <p>Connected load : 43 MW = 43×10^3 kW</p> <p>Maximum demand = 20 MW = 20×10^3 kW</p> <p>Energy generated : 61.5×10^6 kWh (Unit is assume KWH)</p> <p>i) Demand factor = $\frac{\text{Maximum Demand}}{\text{connected load}}$ ----- (1 Mark)</p> <p style="text-align: center;">$= \frac{20 \times 10^3}{43 \times 10^3}$</p> <p>Demand factor = 0.4651 ----- (1 Mark)</p>



	<p>ii) Load factor = $\frac{\text{No. of unit generated in one year}}{\text{No. of hour in one year} \times M. D}$ (1 Mark)</p> <p style="text-align: center;">$= \frac{61.5 \times 10^6}{8760 \times 20 \times 10^3}$</p> <p>Load factor = 0.3510 (1 Mark)</p> <p>Load factor = 35.10 %</p>
f)	List out any four limitations of wind energy.
Ans:	<p>Following are the limitations of wind energy:- (Any four limitation are expected : 1 Mark each)</p> <ol style="list-style-type: none">1. Wind turbine produces noise.2. In case of low wind, power cannot be generated.3. Its efficiency is low (20% -30%).4. There is limitation on site selection.5. Transportation cost of wind tower and accessories is high.6. It disturbs road traffic during transportation of heavy wind tower and accessories.7. Installation cost of wind tower is high and difficult8. Wind plant has a relatively high overall weight.9. It kills the large birds some time when the birds collide to the turbine blades (wind turbines are death machines for large birds)10. Wind turbine structures, can interfere with communication or radar signals when these signals interrupted by the turbine structure or the rotor.11. Capital cost per MW of power plant is more.12. Its reliability to generate power is less.13. No firm power.14. Its efficiency is less.15. There is no guaranty that power is generated during peak hours or whenever needed.16. Power generation is not phase with demand.