



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 to day life. (any two points)	
Ans:	(Any two points are expected: 1 Mark each: Total : 2 Marks)	
	Importance of electrical power in day to day 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.	
	3. 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	



b)	State the function of super heater of a thermal power plant.
Ans:	Function of Super heater: - (2 Marks) Its function is to increase the temperature of steam by absorbing heat from exhausted hot flue gases.
c)	State advantages of Pulverized coal w.r.t. thermal power plant.
Ans:	Advantages of Pulverized coal w.r.t. thermal power plant. (Any two points are expected: 1 Mark each: Total : 2 Marks) <ol style="list-style-type: none">1. Due to pulverization amount of fuel required to produce same amount of heat reduces.2. Time required for combustion reduces3. It gives more heating surface area.4. High temperature can be produced in furnace.5. Due to pulverizing low grade coal can be burned easily.6. It requires low air pressure.7. Efficiency of fuel increases.8. Firing of pulverized coal is easy.9. Ash produced quantity reduces.10. The requirement of air for complete combustion is reduced, because of the increased surface area per unit mass of coal.11. The firing can be controlled to match the load requirements.12. Rapid and efficient starting of the boilers from cold.13. The ash-handling problems are reduced to a minimum, i.e., practically there are no ash-handling problems.14. Less furnace volume.15. Because of the smaller requirement of air and thorough mixing of air and fuel, very high-combustion temperatures can be attained.



MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
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Winter– 2018 Examinations

Subject Code: 17324

Model Answer

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d)	Name the turbines used in HPS. For the heads 30 M and less and 200 M and above.																																																												
Ans:	For the heads 30 M and less : (Any Two Names expected: 1/2 each, Total 1 Mark) <ol style="list-style-type: none">1. Multi jet pelton wheel2. Cross flow turbine3. Turgo turbine4. Francis turbine5. Overshot Water Wheel6. Pitch back Water Wheel For the heads 200 M and above:- (Any Two Names expected: 1/2 each, Total 1 Mark) <ol style="list-style-type: none">1. Francis turbine2. Pelton wheel turbine																																																												
e)	State any four locations of Hydro power plants in India with their capacities.																																																												
Ans:	(Any Four Location Expected: 1/2 each: Total 2 Marks) <table border="1"><thead><tr><th>S.No</th><th>Station</th><th>District</th><th>State</th><th>MW</th></tr></thead><tbody><tr><td>1</td><td><u>Koyna</u></td><td><u>Satara</u></td><td><u>Maharashtra</u></td><td>1,960</td></tr><tr><td>2</td><td>Ghatghar Dam</td><td><u>Ahmednagar</u></td><td><u>Maharashtra</u></td><td>250</td></tr><tr><td>3</td><td>Ujjani Dam</td><td>Solapur</td><td><u>Maharashtra</u></td><td>12</td></tr><tr><td>4</td><td>Dimbhe dam</td><td>Pune</td><td><u>Maharashtra</u></td><td>5</td></tr><tr><td>5</td><td>Manikdoh Dam</td><td>Pune</td><td><u>Maharashtra</u></td><td>6</td></tr><tr><td>6</td><td>Radhanagari Dam</td><td></td><td><u>Maharashtra</u></td><td>4.8</td></tr><tr><td>7</td><td><u>Srisaillam Dam</u></td><td></td><td><u>Andhra Pradesh</u></td><td>1,670</td></tr><tr><td>8</td><td><u>Sharavathi</u></td><td></td><td><u>Karnataka</u></td><td>1,608.2</td></tr><tr><td>9</td><td><u>Chamera Dam</u></td><td><u>Chamba</u></td><td><u>Himachal Pradesh</u></td><td>1,071</td></tr><tr><td>10</td><td>Karcham Wangtoo</td><td>Kinnaur</td><td>Himachal Pradesh</td><td>1,000</td></tr><tr><td>11</td><td>Indira Sagar</td><td>Khadwa</td><td>Madhya Pradesh</td><td>1,000</td></tr></tbody></table>	S.No	Station	District	State	MW	1	<u>Koyna</u>	<u>Satara</u>	<u>Maharashtra</u>	1,960	2	Ghatghar Dam	<u>Ahmednagar</u>	<u>Maharashtra</u>	250	3	Ujjani Dam	Solapur	<u>Maharashtra</u>	12	4	Dimbhe dam	Pune	<u>Maharashtra</u>	5	5	Manikdoh Dam	Pune	<u>Maharashtra</u>	6	6	Radhanagari Dam		<u>Maharashtra</u>	4.8	7	<u>Srisaillam Dam</u>		<u>Andhra Pradesh</u>	1,670	8	<u>Sharavathi</u>		<u>Karnataka</u>	1,608.2	9	<u>Chamera Dam</u>	<u>Chamba</u>	<u>Himachal Pradesh</u>	1,071	10	Karcham Wangtoo	Kinnaur	Himachal Pradesh	1,000	11	Indira Sagar	Khadwa	Madhya Pradesh	1,000
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f)	What is meant by nuclear Fission ?
Ans:	Nuclear Fission:- (2 Marks) The process in which heat energy is released without using oxygen for combustion in process is known as nuclear Fission.
g)	List out main components of Reactors.
Ans:	List the main components of Reactors: (Any Four components expected: 1/2 Marks each , Total 2 Marks) 1. Core 2. Nuclear fuel (U^{235}) 3. Moderator 4. Control Rod 5. Reflector 6. Reactor vessel 7. Shielding
h)	List out main components of Diesel power station.
Ans:	Main components of Diesel power station: (Any Four components expected: 1/2 each, Total: 2 Marks) 1) Diesel Engine 2) Engine Air intake system 3) Engine Fuel System 4) Engine Exhaust system 5) Engine cooling system 6) Engine Lubricating system 7) Engine Starting system 8) Diesel Engine Generator (Alternator)



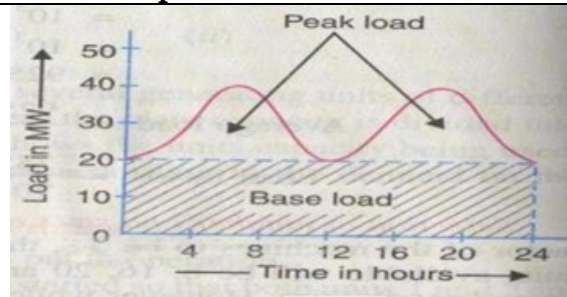
i)	State two advantages of interconnection of power stations.
Ans:	<p><u>Advantages of interconnected power system:-</u></p> <p>(Any Two advantages are expected: 1 Mark each point, Total : 2 Marks)</p> <ol style="list-style-type: none">1) Due to interconnection it is possible of wheeling of electricity instantly.2) The reliability and continuity of the supply is improved with interconnected grid system. With fault condition occurring in any one generating station, the supply can be maintained with the help of other generating stations.3) Inter connected power systems reduce the overall requirement of installed capacity to fulfills the peak demand.4) With interconnected grid system the economical operation of the plant is possible. e.g.<ol style="list-style-type: none">a. To run power plant for the maximum <u>time whose operating cost is minimum.</u>b. Plants <u>with higher operating cost</u> are only loaded (started) when required (during peak hours)c. And those <u>with maximum operating cost</u> are kept in reserve and would operate only in case of emergency.Due to this flexibility power can be supplied with minimum cost/ unit.5) With interconnected grid system, It is possible to arranged the total load in such a way that<ol style="list-style-type: none">a. More efficient plants can be used as base load stations which can work continuously throughout the year at high load factor.b. The less efficient plants can be made to operate as peak load plants.6) With interconnected grid system, it is possible to use older and inefficient plants can be effectively used.7) Due to interconnection generating unit of higher capacity (500MW & above) can be installed & operate economical8) In combine operation of several plants the reserve capacity required to each individual power plant <u>is reduced or not required also</u>, so it reduces initial as well as operating cost of plant.



- 9) The load factor, diversity factor, power factor & efficiency of operation are improved.
- 10) Better utilization of hydro power due to combined operation with thermal power plant.
- 11) Isolated power systems have higher frequency fluctuations with change in load. With inter connections, the system becomes stronger & the effect of load variation is reduced.
- 12) Due to interconnection it is easy for planning, co-ordination, supervision & control over complete transmission system is possible.
- 13) To supply power in most economic manner is possible.
- 14) Due to interconnection, there is optimum utilization of available natural resources in the country is possible.

j) Define base load and peak load.

Ans:



or equivalent figure

1) Base Load: (1 Marks)

The load which is constant and which occurs almost whole day (24 hours) on the generating station is known as base load. OR

The electricity "base load" is the minimum level of demand on an electrical supply system over a 24 hour period.

2) Peak Load: (1 Marks)

The load which is vary time to time over and above the base load on generating station is known as peak load.



k)	State any two fuels used in NPS with their mass numbers and atomic numbers.
Ans:	<p style="text-align: center;">(Any two Fuels expected: 1 Marks each , Total 2 Marks)</p> <ol style="list-style-type: none">1. <u>Natural Uranium</u> (It contains only 0.72% U^{235})2. <u>Low -enriched Uranium</u> (It contains 3 to 4% U^{235})3. <u>Highly -enriched Uranium</u> (It contains 90% U^{235})4. <u>Fertile Material:-</u> U^{238} / Th^{232}
l)	State any four applications of Diesel power station.
Ans:	<p>Applications of Diesel Power Station:</p> <p style="text-align: center;">(Any Four applications expected: 1/2 Mark each, Total 2 Marks)</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)	State the different methods of Power Generation adopted in India.	
Ans:	<p style="text-align: center;">(Any four methods are expected 1 Mark each, Total 4 Marks)</p> <ol style="list-style-type: none">1. Hydro energy or hydro Electric power plant2. Nuclear energy or nuclear Power Plant3. Fossil fuels:<ol style="list-style-type: none">i) Thermal energy (by combustion of coal) or Thermal Power Plantii) Natural gas energy or Gas Power Plantiii) Diesel energy or Diesel Power Plant4. <u>Solar Energy</u>: Solar Power plant<ol style="list-style-type: none">i) <u>Photovoltaic Systems</u> (Direct conversion to electricity)ii) Solar Thermal Power plant (In direct conversion to electricity)5. <u>Geothermal Energy</u> or Geo thermal Power Plant6. <u>Bioenergy</u>: Bio-Mass Power Plant<ol 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	
b)	"Efficiency of thermal power station is low". – Justify.	
Ans:	<p>Justification: Efficiency of thermal power station is low":- (4 Marks)</p> <p>Overall efficiency of T.P.P depends upon efficiency of boiler, turbine and alternator.</p> <p>The heat produced due to combustion of coal is not fully utilized for generation of electrical energy because there are total losses in thermal power plant is 71%, so efficiency of thermal power Station is Low</p> <p style="text-align: center;">OR</p>	



a) Boiler House losses:

- i) Flue gases -5 %
- ii) Moisture in gases-5%
- iii) To ash-1%
- iv) Radiation and leakage losses-2.5 %
- v) Unknown losses-2.5%

Therefore total losses in boiler-16%

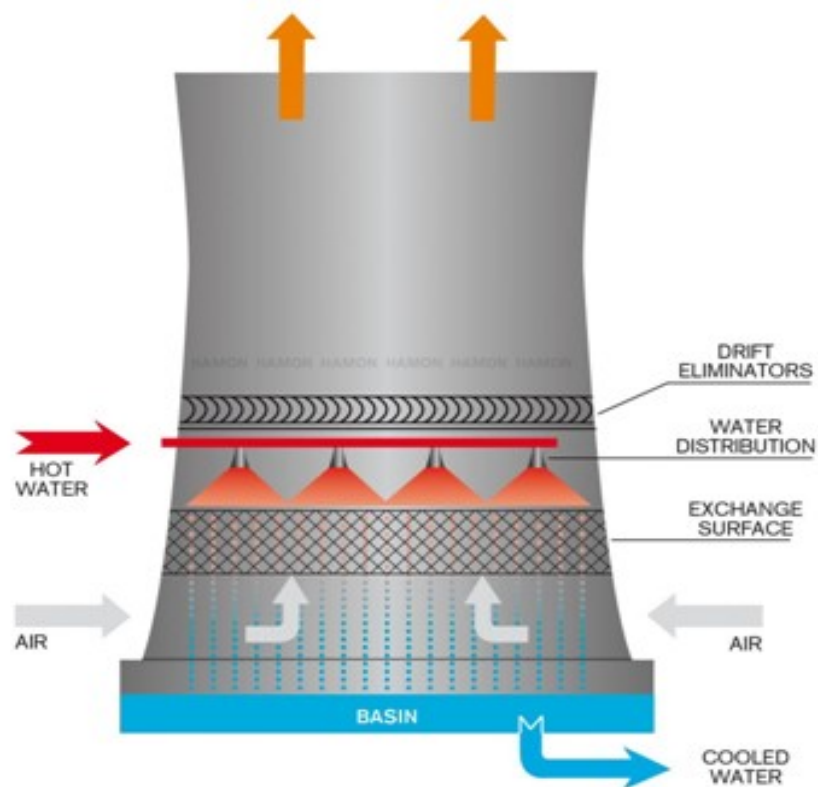
b) Turbine losses: heat rejected to condenser i.e turbine losses is 54 %

c) Electrical losses- 1 %

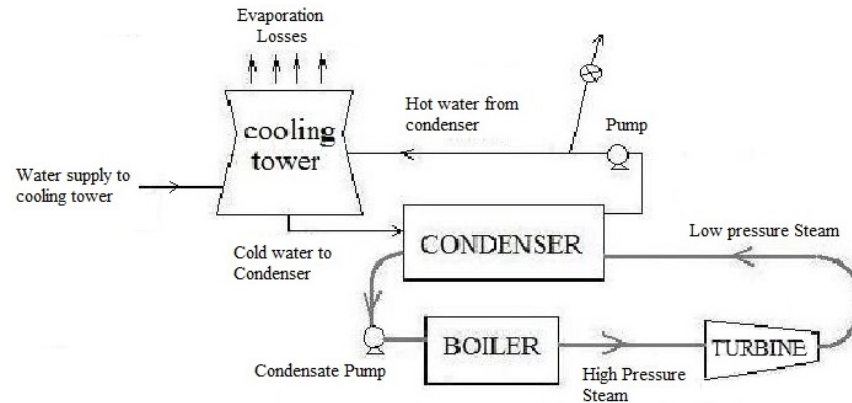
Therefore total losses in thermal power plant is 71%, So efficiency of thermal power plant is less about 29%

c) Draw and explain the function of cooling tower in TPS.

Ans: **Cooling tower in TPS: (Diagram: 2 Marks & Function: 2 Marks, Total: 4 Marks)**



OR



or equivalent figure

- **The function** of cooling tower is to reduce the temperature of water coming from condenser.
- Water is circulated from the basin of the cooling tower to the condenser. It absorbs heat from the steam and get warm.
- This warm water is return to the cooling tower to reduce the temperature.
- Hot water from condenser outlet is dropped from a height of about 8-10 m. The cooling tower reduces the temperature of the hot water by about 7°C- 10°C, as it falls down into the basin at the bottom of the cooling tower.
- This water at the reduced temperature is recirculated through the condenser and the cycle is repeated.
- In cooling Tower temperature of water is reduced either by natural or forced or induced draught method or combine

d)

What are the main electrical equipment used in HPS ? State the function of each parts of it in brief.

Ans:

Following Main Electrical Equipment used in HPS & their function:

(Function of each equipment : 1 Mark, Total 4 Marks)

1. Alternator
2. Exciter
3. Transformer
4. Switchgear



Function :

1) Alternator:-

Alternator is coupled to water turbine and converts mechanical energy of the turbine into electrical energy. The alternator may be hydrogen or air cooled. The necessary excitation is provided by means of main & pilot exciters directly coupled to the alternator shaft.

2) Exciter:-

Exciter is Dc compound generator. It is mounted the same shaft of the Water turbine and alternator. It excites the field winding of alternator.

3) Transformer :-

A generating station has different types of transformers viz,

- **Main step-up transformer** which step-up the generation voltage for transmission of power.
- **Station Transformer** which are used for general services (e.g lighting) in the power station.
- **Auxiliary transformer** which supply to individual unit-auxiliaries.

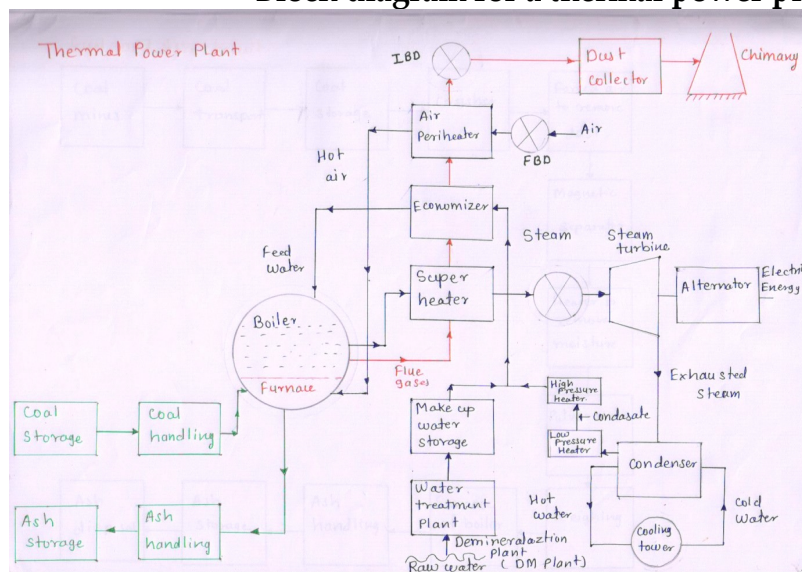
4) Switchgear: -

It houses such equipment which locates the fault on the system and isolates the fault part from the healthy section. It contains circuit breaker, relays, switches and other control devices.

e) Draw the schematic block diagram of Thermal Power Station.

Ans: **Schematic block diagram of Thermal Power Station: (4 Marks)**

Block diagram for a thermal power plant



or equivalent Figure



	<p>penstock.</p> <ul style="list-style-type: none">➤ Such plants can be operated only in <u>interconnected system</u>, where other generating plants (such as <u>TPP & NPP</u>) are available during their off load period.➤ In this case, Francis turbine is used <p>Advantages of Pumped storage Power Plant; (Any Two point Expected)</p> <ol style="list-style-type: none">1. It is saves water by reusing same water again & again.2. There is less expenditure during pumping of water because water is pumped when surplus power is available i.e. during OFF load period. (Through interconnected system)3. It can be put into service immediately; hence it is useful to supply power during peak load period.4. It increases load factor of power plant (generally TPP)5. It helps in reducing install as well as spinning reserve capacity of TPP as it provides additional power during peak load period.
b)	State disadvantages of nuclear power station.
Ans:	<p>Disadvantages of Nuclear Power Plant: -</p> <p style="text-align: center;">(Any Four Point Expected: 1 Mark each, Total: 4 Marks)</p> <ol style="list-style-type: none">1. The capital cost of Nuclear power plant is very high as compare 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 require to handle the plant.i.e. it requires high skill technician which rises the running cost due to high salaries.4. The fuel used is expensive.and <u>It must be stored safely</u>5. The fission(nuclear chain reaction) products are radioactive and may cause dangerous amount of radioactive pollution if proper care is not taken.

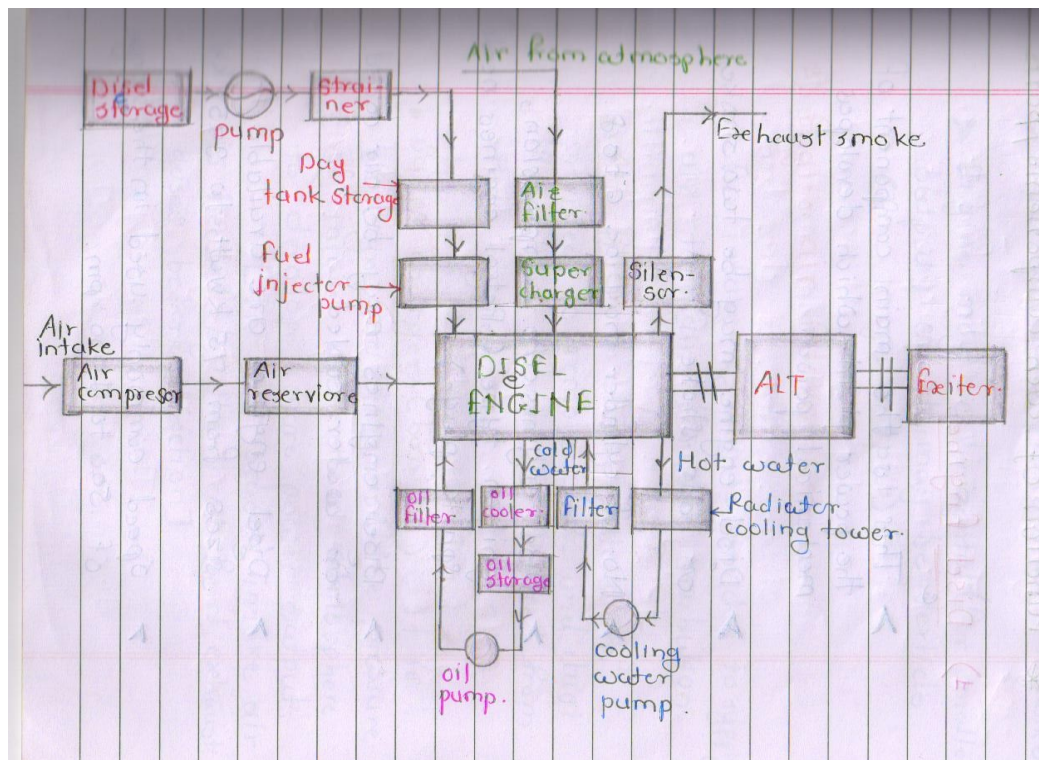


6. It is difficult to build a plant with 100% safe from radioactive radiation.
7. The disposal of radioactive waste is a big problem and is hazardous to health for thousands of years.
8. Disposal of nuclear waste requires high cost.
9. Nuclear power plant not suitable for variable load. (*As reactor can not be easily controlled*)
10. Generation Cost per unit is more, because of additional expenses like security.
11. The cooling water requirements of NPP are very heavy.
12. Cooling towers required for NPP are larger & costlier than TPP.
13. Time required for erection is more.
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.

c) Draw the block diagram of a diesel power plant and show all its important parts.

Ans: Block diagram of a diesel power plant:

(4 Marks)



or equivalent Figure



d)	State four special features of a turbo alternator used in TPS.
Ans:	<p style="text-align: right;">(Any four features are expected 1 Mark each, Total 4 Marks)</p> <p>Special features of a turbo alternator used in TPS:</p> <p>Special Futures (Highlights):</p> <ul style="list-style-type: none">➤ It is 3-phase generator.➤ A separate excitation is given to alternator by DC generator (Exciter) which is mounted on same shaft.➤ Pilot Exciter is used to excite the main exciter.➤ Generated voltage is 3.3KV, 6.6Kv, 11KV, 17.5KV and 20 KV.➤ Construction of rotor is cylindrical type.➤ Numbers of poles to alternator are two or four.➤ Alternator is smaller in diameter and longer in axial length.➤ It is robust in construction.➤ Generator is high speed machine compare to the water turbine driven generator.(It's a synchronous speed is 3000 RPM for two poles and 1500 RPM for 4 poles to get 50 Hz frequency.)➤ Cooling is necessary to improve the performance of alternator. Cooling system may be air cooled or hydrogen cooled.➤ Standard rating of turbo alternator is 125, 200, 300 and 500 M watt and Maximum rating of turbo alternator is 500 M watt.➤ Various protections are provided to alternator.<ul style="list-style-type: none">•Over voltage and under voltage protection.•Over frequency under frequency protection.•Over load protection.•Over temperature protection
e)	State the effect of Water hammering effect in penstock of HPS and method to reduce it.
Ans:	<p>Water hammering effect in penstock of HPS: (2 Marks)</p> <p>When load on power plant or alternator decreases then Governor (valve) reduces discharge of water. Due to sudden reduction in water discharge causes increase in pressure of the water in the penstock. Due to high pressure penstock may damage. This effect is known as 'Water hammer effect'.</p> <p style="text-align: center;">OR</p>



When load on power plant or alternator decreases then

- Governor (valve) reduces discharge of water.
- Due to sudden reduction in water discharge causes increase in pressure in the penstock.
- Due to high pressure penstock may damage.
- This effect is known as 'Water hammer effect.

Method of Water hammering Effect is reduced: -

(2 Marks)

With the help of surge tank water hammer effect is eliminated OR
At that time surge tank helps by storing this rejected water immediately. In this way it avoids water hammer effect.

f) Explain the procedure adopted for the disposal of Nuclear Waste.

Ans:

(Any four points are expected, 1 Mark each, Total 4 Marks)

Following the procedure adopted for the disposal of Nuclear Waste:

- Nuclear waste disposal in nuclear power station:

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.

- **Solid Waste Disposal:-**

- Solid wastes removed from the reactor are very hot and radioactive.
- Solid waste is filled in a sealed container.
- And is kept under water for 5 to 10 years under supervision to reduces its temperature.
- The solid waste container is buried deeply in the ground by making tunnel,



however the area must be unused land, away from populated area and there is less rain fall in that area.

OR

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

OR

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

➤ Liquid Waste Disposal:-

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

➤ Gaseous Waste Disposal:-

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

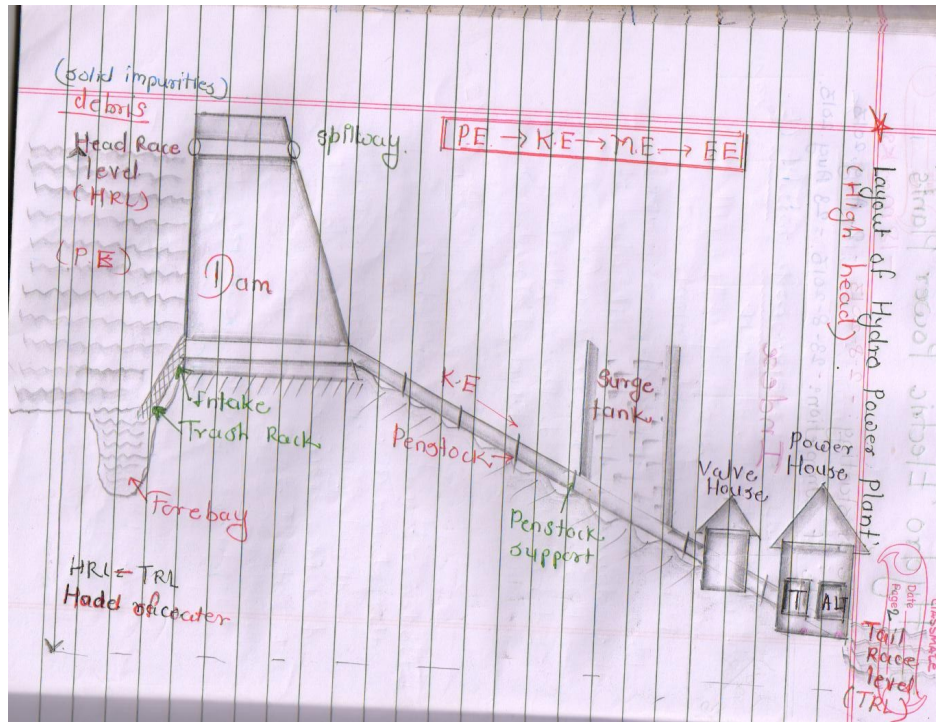


a) Explain the working of Hydro power station with schematic layout.

Ans:

Schematic layout of Hydro Power Station:

(Schematic Layout : 2 Marks & Working : 2 Marks: Total 4 Marks)



or equivalent Figure

Working of Hydro- Electric Power Plant:

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

Thus potential energy of water is converted into kinetic energy in penstock and turbine converts kinetic energy into mechanical energy and Alternator is coupled to water turbine which converts mechanical energy into electrical energy.

b) State elements of diesel electric power plant with their functions.



Ans:	<p>Elements of Diesel Power Plant with their function):</p> <p style="text-align: center;">(Any four elements expected: 1 Mark each, Total : 4 Marks)</p> <ol style="list-style-type: none">1) <u>Diesel Engine</u>: - This is the main component of the P.P. which develops mechanical power.2) <u>Engine air intake system</u>: - Air intake system is provided to supply air to engine cylinder for fuel combustion.3) <u>Engine fuel System</u>: - It supplies fuel to engine cylinder for combustion purpose.4) <u>Engine exhaust system</u>: - This system is provided to discharge the engine exhaust (Smoke) to the atmosphere.5) <u>Engine cooling System</u>: - The water (Coolant) which is circulated in the engine for cooling purpose becomes heated which is cooled in <u>Engine cooling System</u> and is recirculated.6) <u>Engine Lubricating System</u>: - It lubricates the rotating and moving parts of engine to reduce wear and tear. The life of engine & its efficiency largely depends on lubricating system.7) <u>Engine starting system</u>: - This system is provided to rotate the engine initially until the firing starts and engine run under its own power.8) <u>Flywheel</u>: - It stores kinetic energy when there is light load or no load and to supply kinetic energy when load increases.9) <u>Governor</u>: - It supplies fuel as per requirement.10) <u>Alternator</u>: - Its function is to convert mechanical power into electrical power.
c)	<p>A generating station has a connected load of 43 kW and M.D. of 20 MW. The energy 61.5x10⁶ KWH per year. Calculate Demand Factor and Yearly load factor.</p>
Ans:	<p>Given Data:</p> <p>Connected load : = 43 kW</p> <p>Maximum demand = 20 MW = 20 x10³ kW</p> <p>Energy generated : 61.5 x 10⁶ kWh</p>



i) Demand factor = $\frac{\text{Maximum Demand}}{\text{connected load}}$ ----- (2 Mark)

$$= \frac{20 \times 10^3}{43}$$

Demand factor = 465.1162791

ii) Load factor = $\frac{\text{No. of unit generated in one year}}{\text{No. of hour in one year} \times M.D}$ ----- (1 Mark)

$$= \frac{61.5 \times 10^6}{8760 \times 20 \times 10^3}$$

Load factor = 0.3510 ----- (1 Mark)

Load factor = 35.10 %

d) Classify condensers used in thermal power station. Explain each type in brief.

Ans: Types of condenser:

(Classification: 2 Marks & Explanation: 2 Marks, Total 4 Marks)

Classification:

1. Jet Condenser (Mixing Type)
2. Surface condenser (non Mixing type)

Explanation:-

1. Jet Condenser (Mixing Type)

In Jet condenser the steam and cold water comes in direct contact with each other. Therefore 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. Due to cold water steam is again converted into water called as condensate.
- Since there is no direct contact between the steam and cooling water. This condensate is reused in boiler.



e)	What is meant by captive power generation also state its advantages?
Ans:	<p style="text-align: center;">(Meaning: 2 Marks, advantages: 2 Marks, Total 4 Marks)</p> <p>Captive power generation: (2 Marks)</p> <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> <p>Advantages of captive power generation:</p> <p style="text-align: center;">(Any Four point expected: 1/2 each point: Total 2 Marks)</p> <ol style="list-style-type: none">1. Reliability of supply increases.2. Power quality is good. (Free from harmonics)3. Transmission losses reduce as generation is nearby load centre.4. Low tariff than Supply Company.5. Surplus energy can be sale easily to other consumers.6. Reduces the load on the grid.7. CPP reduces economic loading on government to build a new power project.8. In some industry like textile and paper manufacturing industry steam is require in manufacturing processes. <p style="text-align: center;">Same steam can be used for generation of electricity. Thus increase efficiency of industry.</p>
f)	State the various factors governing selection of site for TPS.
Ans:	<p>Following various factors governing selection of site for TPS.:-</p> <p style="text-align: center;">(Any Four Point expected: 1 Mark each, Total: 4 Marks)</p> <ol style="list-style-type: none">1. It should locate near coal mines.2. Sufficient quantity of water should be available.



3. Sufficient large space should be available.
4. It should be located near load center.
5. There should be easy access towards power plant.
6. Cost of land should be less.
7. Land should be of good bearing capacity.
8. It should be located away from populated area.
9. Skilled & unskilled labor should be available.
10. Area should be free from earthquake.

OR

1. Distance from coal mines :-

The power plant should be near the coal mine ,so that cost of fuel transportation reduces. large amount of coal is required for producing steam eg. For 2000 MW capacity power plant requirement of coal is 20000 T/day.

2.Availability of Water :-

Sufficient quantity of water should be available because water is as good as secondary fuel which is required for producing steam and for condensing plant. So,plant should be located near river, water resevaior as far as possible.

3. Availability of land (Space availability) :-

The power plant should have sufficient large space available for coal storage & ash disposal.Also for Future extensions of the power station should be possible. Sufficient land must be available nearby the power station to build the residential accommodation to the operation and maintenance staff.

4. Near Load Centre :-

Power Plant should be located near load centre to reduce transmission cost & transmission Losses.

5. Easy acces :-

There should be easy acces towards site of power plant for transfortation of machinery, man power, fuel etc. also easy acces for train,



	<p>road and even ships.</p> <p>6. Cost of land :- To reduce capital cost of power plant, cost of land should be less as sapce required is more.</p> <p>7. Condition of soil (Land):- The land should be rocky (Hard murrum) for the better foundation of building and machianry. The soil should not be too loose or too rocky.</p> <p>8.Distance from populated area:- It should be located at a resionable distance away from the populated area. Because smoke & other hazards gases are produced due to combusion of the coal which causes air pollution.</p> <p>9. Availability of labour:- Skilled and unskilled labour should be availalbe nearly. To the extent possible, the thermal station should be far away from an aerodrome</p>
Q.5	Attempt any FOUR of the following 16 Marks
a)	State the function of biological shielding in case of Nuclear Reactor and give material used for it.
Ans:	<p>Function of biological shielding in Nuclear Reactor: (2 Marks)</p> <p>Shielding is provided to absorb alpha, beta particles and gama rays which are produced during nuclear chain reaction (fission process)</p> <p>The function of shielding is to protect environment, humans and animals from the harmful radioactive radiation (pollution) before they are emitted to atmosphere.</p> <p>Material used for Shielding is made from:- (2 Marks)</p> <ol style="list-style-type: none">1. Thick layer of Paper are provided to stop the alpha particles2. Thick layer of metal or Aluminum are provided to stop the beta particles3. Thick layer of lead or concrete wall are provided all around the reactor vessel(3- m thick concrete shield) for stopping gama rays4. Thick layer of Water or concrete wall are provided all around the reactor vessel for stopping neutrons.



b) What are the basic requirements of locating wind power plant ?

Ans: The basic requirements of locating wind power plant:

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

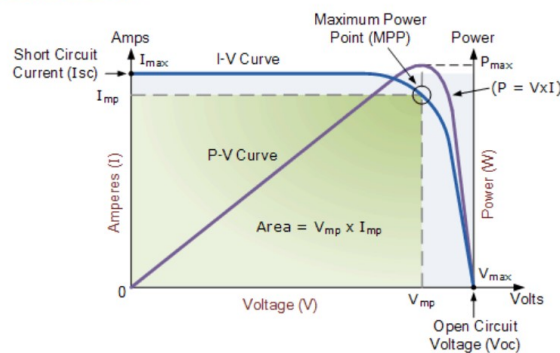
- 1) The site should be selected where winds are strong i.e. where pressure of wind is high and there is continuity.
- 2) Wind pressure is high in hilly area so wind turbines are located in hilly area.
- 3) It is better to choose a site near the seashore, ON shore (coastal area)
- 4) Winds turbines are also installed OFF shore
- 5) Plant must be installed on tall towers (45m to 149 m) because velocity of wind is more at high level.
- 6) Site should be convenient for transportation facility.
- 7) The cost of land should be low.
- 8) A good location for a wind turbine is on high ground facing between west and south - west.
- 9) There should be no tall obstacles within 50m of the turbine which can affect the system's overall performance.
- 10) Possibility to connect to power grid.

c) Explain the characteristics of solar cell.

Ans: Characteristics of solar cell :

(4 Marks)

Solar Cell I-V Characteristic Curve



or equivalent figure

Explanation :-

Solar cells produce direct current (DC) electricity and current times voltage equals power, so we can create solar cell I-V curves representing the current versus the



voltage for a photovoltaic device.

Solar Cell I-V Characteristics Curves are basically a graphical representation of the operation of a solar cell or module summarising the relationship between the current and voltage at the existing conditions of irradiance and temperature. I-V curves provide the information required to configure a solar system so that it can operate as close to its optimal peak power point (MPP) as possible.

d) Compare the Nuclear power station with Hydro power station.

Ans:

(Any Four Point Expected: 1 Mark each, Total 4 Marks)

SR. No.	Points	Nuclear Power plant	Hydro Power station
1	Site/ Location	Where there is ample supply of water is available, away from thickly populated areas to avoid radioactive pollution.	Such power plant located at a place where rain fall is more and there is natural head available.
2	Space Required/ Requirement	Required least space compare to TPP & HPP of same capacity	More space is required due to large water reservoir(Back water)
3	Auxiliaries equipment requirements	Auxiliary's equipment requirements more than hydro power plants.	Auxiliary's equipment requirements are less.
4	Initial /capital cost	Highest due to complex Nuclear reactor.	High due to construction of dam.
5	Running/operating cost	High running cost.	Running cost is lowest.
6	Maintenance cost	Highest cost	High cost
7	Cost of Fuel	Expensive	Freely available.
8	Fuel Transportation cost	More fuel transportation cost.	No fuel transportation cost.
10	Overall Generating cost	More	Less

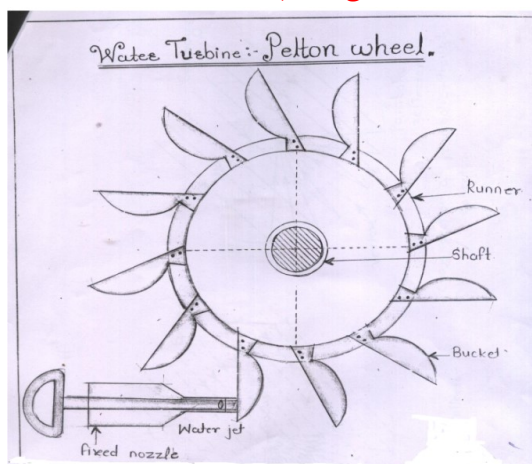


11	Air Pollution	Less as compare to TPP but produces nuclear waste, which is currently a problem	No air pollution.
12	Simplicity & cleanliness	Complicated & Clean	Simple & clean
14	Reliability	Highest	Highest
15	Stand by losses	stand by losses are their	No stand by losses
16	Overall Efficiency	Moderate (50 to 55 %).	Highest (96%)
17	Limit of source of power	Unlimited, since large deposits of fissionable materials over the world are available.	Unlimited & inexhaustible
18	Erecting period	5 to 7 Years	7 to 10 Years
19	Field Application	As base load	Used as base load during as well as peak load

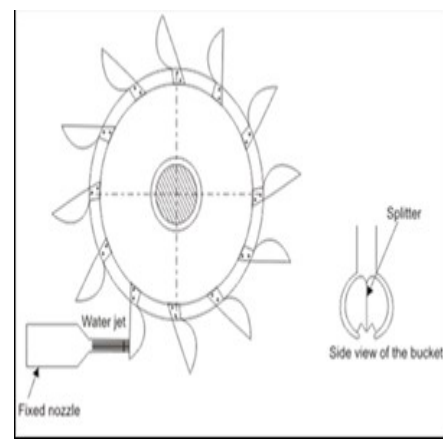
e) Explain with neat diagram construction of pelton wheel turbine.

Ans: Diagram of Pelton Wheel:-

(Diagram : 2 Marks & Construction : 2 Marks, Total 4 Marks)



OR



OR Equivalent Figure



Construction of Pelton Wheel Turbine:

1. Runner with Bucket: The runner of a pelton turbine consists of a number of double cupped buckets surrounded to the periphery of the wheel.

Material for bucket is cast iron for low head plant and cast steel, stainless steel and bronze for medium and high heads. The buckets are either cast integral with the wheel or bolted to the rim.

Bolted arrangement is preferred as the damaged bucket can be easily replaced.

2. Nozzle with guide mechanism: The function of the nozzle of a pelton wheel is to convert the available pressure energy into high velocity energy in the form of jet. The quantity of water required is proportional to the load on the turbine. Therefore, to control the flow through the nozzle, some most of a regulating or a governing mechanism is necessary. This is generally done by using a spear inside the nozzle.

A brake nozzle is used in case of large turbine. When the wheel is to be stopped, besides cutting off the supply of water through the main nozzle.

3. Casing : Casing of a pelton turbine is not to perform any hydraulic function. However, a casing is necessary to avoid accidents, splashing race and to support the housing for the bearing and the nozzle.

f) **Give comparison of BWR and PWR.**

Ans:

(Any Four point Expected: 1 Mark each, Total; 4 Marks)

Sr.No.	Points	Boiling Water Reactor (BWR)	Pressurized Water Reactor (PWR)
1	Construction	It consist of reactor vessel & there is no heat exchanger	It consist of strong pressure reactor vessel and heat exchanger
2	Principle	Steam is generated in the reactor itself.	Steam is generated in heat exchanger.
3	Fuel	Enriched Uranium	Enriched Uranium
4	Heat transfer loss	No heat transfer loss	There are heat transfer losses.



5	Cost	Less than PWR	More than BWR as strong pressure reactor vessel is required.
6	Steam pressure	Steam pressure produced 68 kg/cm ²	Steam pressure produced 52 kg/cm ²
7	Temperature	Temperature of steam 280 ^o c.	Temperature of steam 260 ^o c.
5	Cooling	Light or heavy water	Light or heavy water but under pressure

Q.6 Attempt any FOUR of the following **16 Marks**

a) State the types of solar collector and explain any one.

Ans: **Types of solar collector:**
(Types: 2 Marks and explanation : 2 Mark, Total: 4 Marks)

1. Flat Plate type collectors :-

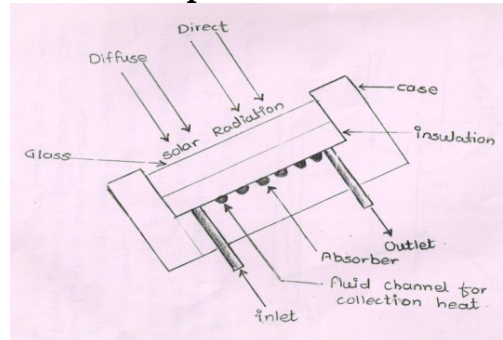
- a) Flat plate collectors (FPC)
- b). Evacuated Tubular collector (ETC)

2. Concentrating type collectors (focusing type collector):

- 1) Linear cylindrical Parabolic(troughs)concentrating collector
- 2) Central receiver Spherical (Dish) Parabolic concentrating Collector
- 3) Central receiver solar tower with number of distributed Concentrating collector

(Explanation of Any one method is expected)

1) Schematic view of Flat plate collector:



or equivalent figure

Construction:

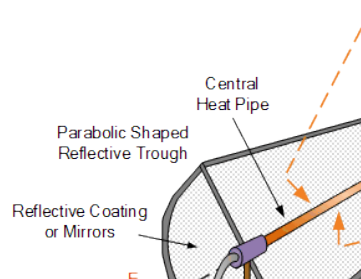
Flat collectors are made rectangular shape.

It consists of main five components:

1. A transparent cover which may be one or more sheet of glass or radiation transmitting plastic film or sheet called as collector.
2. Tubes or pipes or channel are connected integral with collector which carry water/fluid/ Air which is to be heated.
3. The absorber plate normally metallic with black surface.
4. Heat insulating material is provided to minimize heat loss.
5. The casing or containers which enclose the other components and protect them from the weather.

2. Concentrating type collectors (focusing type collector):

a) Line focusing concentrating type collector:



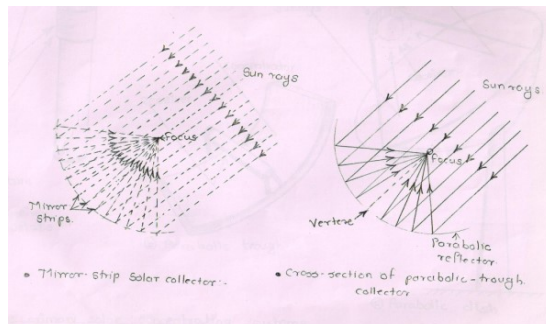
or equivalent figure



Construction:

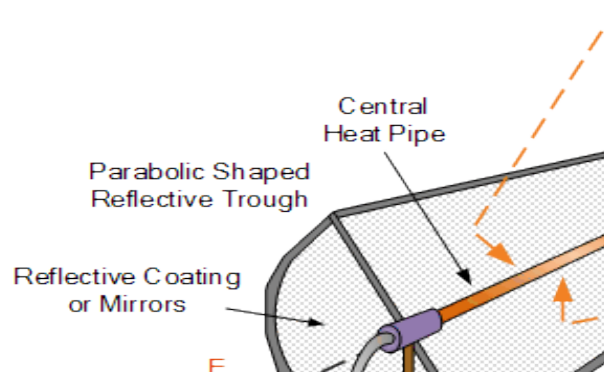
- It consists of cylindrical parabolic collector (concentrator) 2-3 mtr. in length, 1-1.5 mtr. in width
- Collector surface has been made of highly polished (*aluminum or silver glass or thin film of aluminized plastic or mirrors on a film base.*)
- And absorber which is well insulated is placed along focus axis.
- In this type solar collector, radiation is collected over the area of the reflecting surface and is radiated towards pipe contains fluid
- Tracking of collector according to sun direction is necessary for better result.
- The tracking is always from south to north direction because there is more solar energy in the direction then the east west arrangement.

b) Point focusing concentrating type collector (Parabola):



OR

Point focusing concentrating type collector (Tower)



or equivalent figure



Construction:

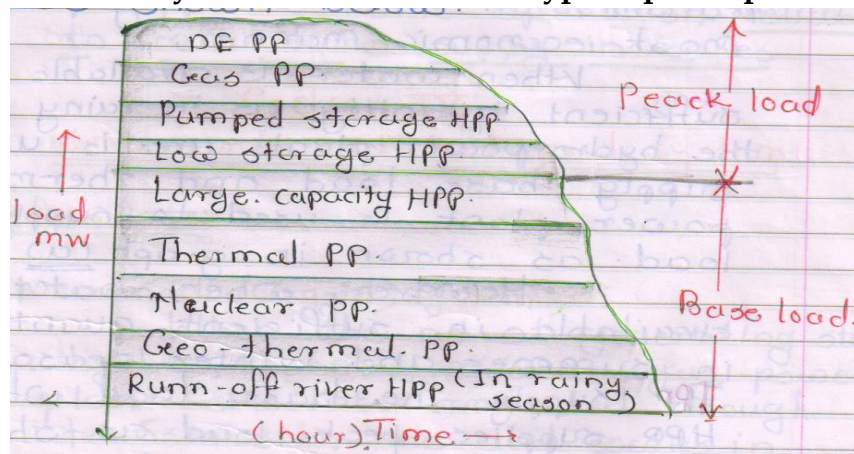
- It consists of disc 6.6 meter in diameter has been made from mirrors formed in to the shape parabola called as concentrator.
- Surface absorber (Receiver) which is well insulated which is located at focal point
 - The concentrator captures and reflect solar radiation towards collector (absorber)
 - The receiver absorbs the concentrated sunlight rays and gets heated.
- The disc can be turn automatically up-down and left-right, so that sun is always kept in a line. Thus the sun can be fully tracked.
- The tracking is always from south to north direction because there is more solar energy in this direction than the East-West arrangement.

b) State, "how priority of use is decided w.r.t. type of power plant".

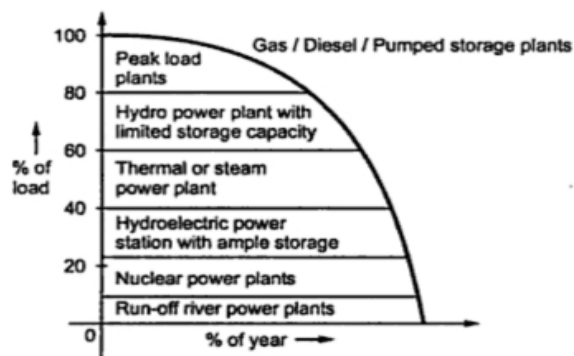
Ans:

(4 Marks)

Priority of use is decided w.r.t. type of power plant:-



OR

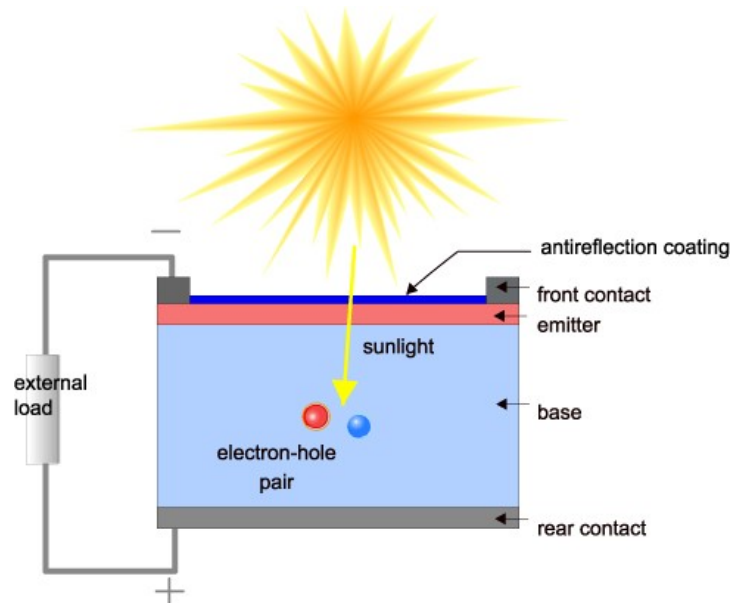
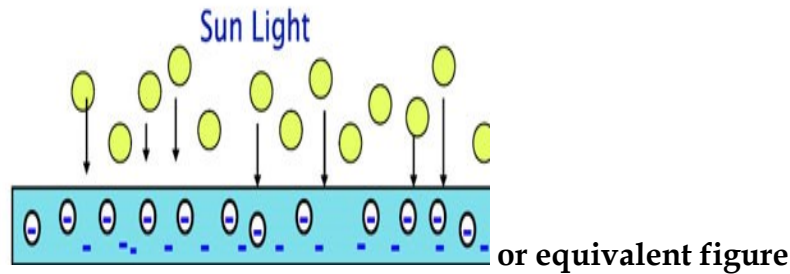




c) Explain with neat diagram the working of photo-voltaic cell.

Ans: Diagram the working of photo-voltaic cell:

(Diagram: 2 Marks & Explanation: 2 Marks, Total 4 Marks)



Working:-

Solar cell operates on principle of Photo-voltaic effect

Solar cell works in following steps:

- 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, -
 - 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



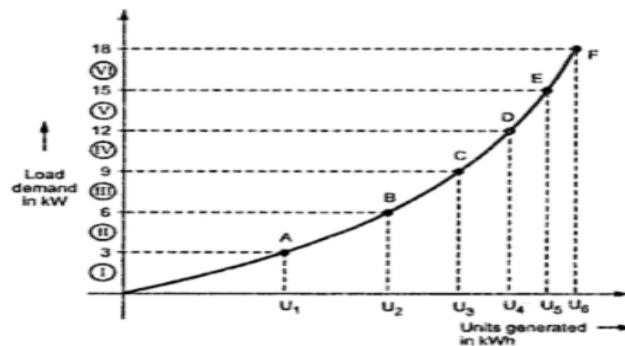
	<p>semiconductor.</p> <p>➤ When you connect loads such as a light bulb, electric current flows between the two electrodes.</p>
d)	Explain multiplication factor and critical size w.r.t. NPS.
Ans:	<p>Multiplication factor: (2 Marks)</p> $\text{Multiplication factor}(k) = \frac{\text{Number of neutrons on any one generating stage during fission process}}{\text{Number of neutrons of premedialy preceding generation during fission process}}$ <p style="text-align: center;">OR</p> $K = \frac{\text{no. of neutrons in the } n \text{ th generation}}{\text{no. of neutrons in the } (n - 1) \text{ th generation}}$ <p><u>Effect of value of multiplication of factor (k):</u></p> <p>➤ When value of (K>1) k is greater than 1 Chain reaction is uncontrolled is called <u>supper critical stage</u> At the time of starting of chain reaction value of 'k' should be kept greater than 1</p> <p>➤ When value of (K=1) k is equal to 1 It means chain reaction proceeds at steady state and can be controlled is called as <u>critical stage</u>. At the time of steady state chain reaction value of 'k' is equal to 1</p> <p>➤ When value of (K<1) k is lesser than 1 It means chain reaction cannot continue is called as <u>sub critical stage</u>. At the time of shutting down chain reaction value of 'k' should be kept less than 1</p> <p>Explanation of Critical size w.r.t. NPS: (2 Marks)</p> <p>➤ If the reactor core is made very small:-</p> <ul style="list-style-type: none">• Then there is more possibility of leakage of neutrons from the reactor core produced during fission process.• Which will affects the fission process. <p>➤ If the reactor core is very large:-</p> <ul style="list-style-type: none">• Then there is no possibility of leakage of neutron from the reactor core produced during fission process.• But this will increase the cost of reactor.



- Critical size:-
 - So size of reactor should not be too large or too small.
 - The size reactor core of should be optimum, so that there will be less leakage of neutrons and less cost of reactor.

e) **Draw and explain integrated duration curve used in system operation.**

Ans: **Diagram of integrated duration curve used in system operation: (2 Marks)**



or equivalent figure

Explanation: (2 Marks)

Integrated duration curve is obtained from load duration curve. It is drawn in between load on Y-axis in KW/MW and the X-axis represents the units generated (KWH/MWH).

Importance of integrated duration curve:

Following information is obtained from integrated duration curve:
It gives the total number of units (KWH/MWH) generated for the given demand in (KW/MW).

OR

The number of units consumed by a load up to a particular time of a day can also be shown on a curve which is called as mass curve.

f) **Why solar system is preferred now a days ? Justify your answer.**

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

Since availability of fossil fuels like coal are limited in future so there is more importance of solar power in the energy deficient because of following advantages of solar power
Fuel is freely available.

1. No air pollution.



	<ol style="list-style-type: none">2. Availability of fuel is unlimited & inexhaustible.3. No fuel storage is required.4. No fuel transportation cost.5. No treatment on fuel is required.6. No waste disposal problem.7. Generating cost per unit is reduces day by day8. No need to start power plant.9. It saves the fossil fuel (coal, diesel, oil etc) which are limited available.12. solar system technology are ideally suited to distributed applications (Decentralized system)
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