



**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.

<b>Q.1</b>	<b>Attempt any TEN of the following</b>	<b>20 Marks</b>			
<b>a)</b>	<b>State any two gaseous fuel.</b>				
Ans:	<b>Following are the gaseous fuel: ( Any Two expected: 1 Mark each, total: 2 Mark)</b> 1. Natural Gas Fuels: a. Biogas b. Petroleum Gas c. Coal Gas d. Natural Gas 2. Manufacturing Gas Fuels; a. Producer gas b. Hydrogen gas c. Refinery gas d. Oil gas e. CNG gas				
<b>b)</b>	<b>List any two thermal power plant with their capacities and location in Maharashtra.</b>				
Ans:	<b>(Any Two power plant name expected: 1 Mark each, Total 2 Mark)</b>				
	<table border="1"><thead><tr><th>Sr.No.</th><th>Name of Thermal Power Plant</th><th>Plant Capacity</th></tr></thead></table>	Sr.No.	Name of Thermal Power Plant	Plant Capacity	
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**MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION**  
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		1	Koradi	1100 MW		
		2	Nashik	910 MW		
		3	Chandrapur	2340 MW		
		4	Parali	1130 MW		
		5	Bhusawal	920 MW		
		6	Paras	500 MW		
		7	Khaparkheda	1340 MW		
		8	TATA (Trombay)	1400 MW		
		9	Dhahanu (Thane)	500 MW		
		10	Wardha	135 MW		
		11	Amravati	2700 MW		
		12	Jindal (Ratnagiri)	1200 MW		
	<b>c)</b>	<b>State the different types of condensers used in Thermal Power Station.</b>				
	Ans:	Following types of condensers used in Thermal Power Station:			<b>(2 Mark)</b>	
		1. Jet Condenser (Mixing Type)				
		2. Surface condenser (non Mixing type)				
	<b>d)</b>	<b>Define penstock in Hydroelectric Plant.</b>				
	Ans:	<b>What is Penstock:-</b>			<b>( 1 Marks)</b>	
		The penstock is the long pipe line. It consists of heavy duty steel pipe.				
		<b>Function of Penstock:-</b>			<b>( 1 Marks)</b>	
		Function of penstock is to carry water from the water intake (reservoir) to turbine.				
	<b>e)</b>	<b>State any two Hydroelectric Power Plants in Maharashtra with their capacities.</b>				
	Ans:	<b>( Any Four Location Expected: 1/2 each: Total 2 Marks)</b>				
		<b>Hydro-electric power stations in Maharashtra:-</b>				
		<b>S.No</b>	<b>Location</b>	<b>Capacity</b>		
		1	Koyana	1960MW		
		2	Mulshi Dam	150MW		



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3	Jayakwadi	12 MW
4	Chadholi(Warana)	16MW
5	Paithon/Ujjani	12 MW
6	Bhira Tail Race	80 MW
7	Veer	9 MW
8	Bhatghar	16 MW
9	Vaitarana Dam	1.5 MW
10	Tillari	60 MW
11	Eldary	22.5 MW
12	Radhanagri	4.8 MW
13	Paitan	12 MW
14	Pawan	10 MW
15	Panshet	8 MW
16	Varasgoan	8 MW
17	Kanher	4 MW
18	Bhatsa	15 MW
19	Dhom	2 MW
20	Manikdoh	6 MW
21	Yeoteshwar	0.075 MW
22	Dimbhe	5 MW
23	Surya	6 MW
24	Surya R.B	0.75 MW
25	Terwabnedhe	0.2 MW
26	Dudhgaon	24 MW
27	Bhandara	34 MW
28	Pench project	53 MW
29	Bhivapuri (TATA)	72 MW
30	Khopoli (TATA)	72 MW
31	Bhira (TATA)	150 MW

f) State any four factors on which location of Nuclear Power Plant depends.

Ans: **(Any four factors for selecting location of nuclear power plant are expected: 1/2 Mark each, Total 2 Marks.)**

Following points should be considered while selecting Power Plant location:-

1) Availability of water:

Water is as good as a secondary fuel, so ample amount of water should be



available near Power Plant so power plant should be located near sea shore, ocean, river etc.

2) **Distance from populated area:**

From the safety point of views, power plant should be located away from populated area.

3) **Easy Access:**

There should be easy access towards site of power plant for transportation of machinery, equipments, fuel and man power etc.

4) **Condition of land soil:-**

Soil should have high bearing capacity .For better foundation of machinery, equipment and building.

5) **Availability of land :-**

Sufficient land should be available for short storage of radioactive waste, for staff quarters and for future expansion of Power Plant.

6) **Cost of land:**

Cost of land should be less, to reduce capital cost of power plant.

7) Plant should be constructed on plain land.

8) **Distance from load center :**

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

9) **Distance from airport:-**

As height of chimney is very high, it should be located away from airport.

10) **Area free from earthquake:**

Area should be free from earthquake and natural hazards.

g) **Name any two parts of reactor and also write their functions w.r.t. NPS.**

Ans: **(Any Two Parts of reactor and their functions expected: 1 Mark each, Total 2 Mark)**

**Parts of reactor and their functions**

1. Core :-

- In which fuels ( $U^{235}$ ) is kept.
- In which heat energy is liberated by nuclear chain reaction.

2. Nuclear fuel ( $U^{235}$ ) :-



- It is in the form of fuel rod.
- It produces heat energy during nuclear chain reaction.
- The nuclear fuels are  $U^{235}$ ,  $U^{233}$ ,  $Pu^{239}$

3.Moderator :-

- 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 reator 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 sheilding is to protect environment, humens and animals from the harmful radioactive radiation (pollution).before they are emitted to atmosphere.
- Shilding is provided to absorb alpha ( $\alpha$ ), Beta ( $\beta$ ) particals and gymma ( $\gamma$ ) rays which are produced during nuclear chain reactions.
- Thick layer of lead or concentrate wall ar provided all over reactor core vessel for stopping ( $\alpha$ ), Beta ( $\beta$ ) particals and gymma ( $\gamma$ ) rays

6.Reactor vessel:-

- Its function is to surrounds core, fuel rod,control rod,moderator, reflector bio-logical 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 manganise.

8.Neutron detector:-

- It is a sensor which detctes neutron.



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	<ul style="list-style-type: none"><li>➤ Its function is to detect how much neutrons are present in the reactor core.</li></ul> <p>9. Control rod :-</p> <ul style="list-style-type: none"><li>➤ Function of control rod is to control the chain reaction by absorbing the neutrons, in reactor core by adjusting its height.</li></ul> <p>10. Coolant:-</p> <ul style="list-style-type: none"><li>➤ Coolant absorbs heat produced in the reactor core is then, transfer to heat exchanger for generation of steam.</li><li>➤ The material used for coolant in the form of gas, liquids, liquid metal.</li></ul>						
<b>h)</b>	<b>State the meaning of 'Captive Power'.</b>						
Ans:	<b>Captive power generation:</b> <span style="float: right;"><b>( 2 Marks)</b></span>  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 <b>captive power generation</b>						
<b>i)</b>	<b>State the different types of engines in Diesel Power Plant.</b>						
Ans:	<b>Different types of Engines in Diesel Power Plant:</b> <span style="float: right;"><b>( 2 Marks)</b></span> i) Two stroke diesel engine ii) Four stroke diesel engine						
<b>j)</b>	<b>Define : (i) Connected load, (ii) Firm Power.</b>						
Ans:	<b>i) Connected Load :-</b> <span style="float: right;"><b>( 1 Marks)</b></span> It is the sum of load of all equipment's connected to supply system which are in use or not in use of each consumer. <b>(ii) Firm Power:</b> <span style="float: right;"><b>( 1 Marks)</b></span> It is the power to be always available even during adverse condition.						
<b>k)</b>	<b>Write difference between cold reserve and hot reserve in Power Plant.</b>						
Ans:	<span style="float: right;"><b>( 2 Marks)</b></span> <table border="1" style="width: 100%;"><thead><tr><th>S.No</th><th>Cold Reserve</th><th>Hot reserve</th></tr></thead><tbody><tr><td> </td><td> </td><td> </td></tr></tbody></table>	S.No	Cold Reserve	Hot reserve			
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	1	It is stand by generating capacity which is available for service but not in operation.	It is reserved generating capacity, in operation but not in service (not connected to bus bar/grid)																																				
1)	<b>State location of any four nuclear plants in India.</b>																																						
Ans:	<b>(Any four nuclear power plants in India with their location expected: 1/2 Mark each, Total 2 Marks.)</b>																																						
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Q.2	<b>Attempt any FOUR of the following</b>		<b>16 Marks</b>																																				
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viii)	Size of selection	Different criteria for different P.P	Site should be selected at source
ix)	For example	HPP, TPP, NPP	SPP and WPP

**b) Write any four advantages and four disadvantages of Thermal Power Plant.**

Ans:

**( Advantages : 2 Marks & disadvantages : 2 Mark, Total 4 Marks)**

**Advantages of Thermal Power Plant –**

**( Any four point expected: 1/2 Mark each, Total 2 Mark)**

**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 load centre it reduces transmission cost and losses in it.

**4. Space required:-**

Less space required as compared to hydro power station.

**5. Generating cost:-**

TPS can be built/construct of high generating capacity.

**6. Generating capacity:-**

TPP can be build/construct of high generating capacity, so used as a base load power plant

**7. Overload capacity:-**

Steam engines and turbine can work under 25% overloads continuously.





**8. Time required for completion of project:-**

Time required for completion of TPP project is very less as compare to hydro power station.

**Disadvantages of Thermal Power Plant –**

**( Any four point expected: 1/2 Mark each, Total 2 Mark)**

**1. Air pollution:-**

It occurs air pollution due to smoke and ash produced during combustion of fuel.

**2. Starting Time:-**

TPP cannot be put into service immediately like HPP. As thermal power plant required few hours (6-7 hour) to generate steam at high pressure and high temperature.

**3. Handling of fuel:-**

Handling of coal and disposal of ash is quite difficult.

**4. Fuel transportation cost:-**

When power plant are located away from coal mines i.e. near load centre at that time fuel transportation cost is more.

**5. Preparation for fuel:-**

There is more expenditure for preparation of coal (raw coal to pulverized coal)

**6. Space required:-**

Large amount of space is required for storage of fuel and ash as compare to NPP.

**7. Efficiency:**

It is less efficient power plant overall efficiency is maximum 30 %.

**8. Stand by losses:-**

Stand by losses are more as furnace is required to keep in operation even when there is no load.



	<p><b>9. Maintenance cost:-</b></p> <p>High maintenance and operating cost because number of auxiliaries plant are required such as coal and ash handling plant, pulverizing plant, condensing plant and water purification plant etc.</p> <p><b>10. Availability of fuel:-</b></p> <p>Less availability of high grade coal.</p> <p><b>11. Simplicity and cleanness:-</b></p> <p>Layout of thermal power plant is complicated than HPP due to coal and ash</p> <p><b>12. Life:-</b></p> <p>Life of TPP is less than HPP</p> <p><b>13. Cost per unit (cost of generation)-</b> High</p>
c)	<p><b>State any four factors on which selection of site for a Thermal Power Plant depends.</b></p>
Ans:	<p><b>Following various factors governing selection of site for TPS:-</b> <b>( Any Four Point expected: 1 Mark each, Total: 4 Marks)</b></p> <ol style="list-style-type: none"><li>1. It should locate near coal mines.</li><li>2. Sufficient quantity of water should be available.</li><li>3. Sufficient large space should be available.</li><li>4. It should be located near load center.</li><li>5. There should be easy access towards power plant.</li><li>6. Cost of land should be less.</li><li>7. Land should be of good bearing capacity.</li><li>8. It should be located away from populated area.</li><li>9. Skilled &amp; unskilled labor should be available.</li><li>10. Area should be free from earthquake.</li></ol> <p style="text-align: center;"><b>OR</b></p>



**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, road and even ships.

**6. Cost of land :-**

To reduce capital cost of power plant, cost of land should be less as sapce required is more.

**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.

**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.

**9. Availability of labour:-**



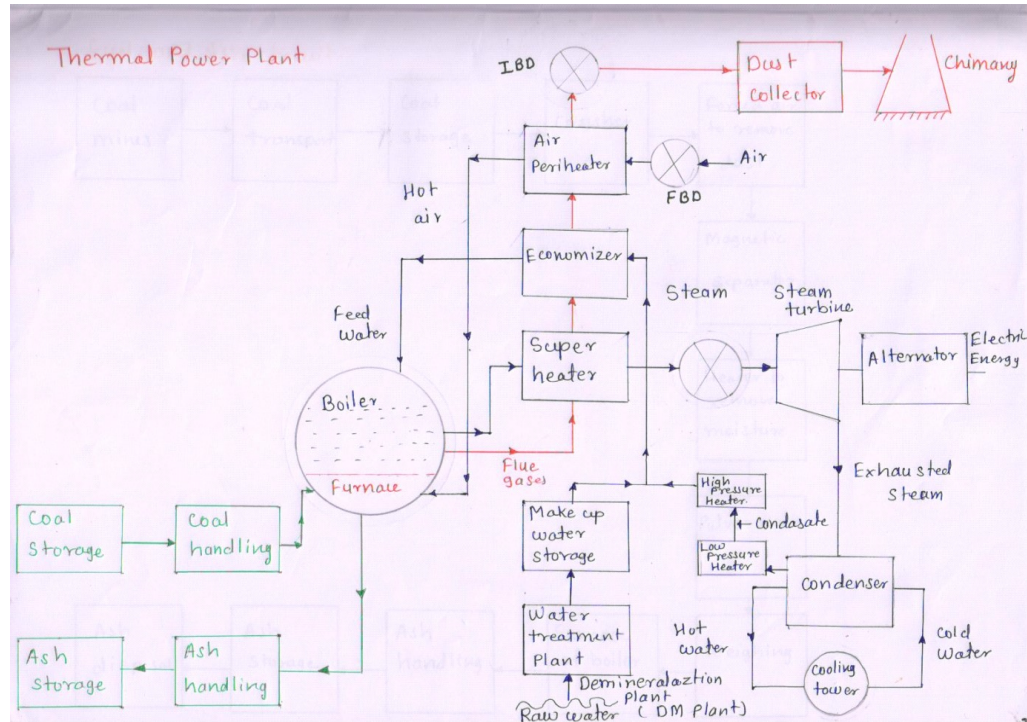
	<p>Skilled and unskilled labour should be available nearby. To the extent possible, the thermal station should be far away from an aerodrome</p>
<b>d)</b>	<b>State any four factors for selection of site for Hydropower Plant.</b>
Ans:	<p><b>(Any four points are expected: 1 Mark each, Total 4 Mark)</b></p> <p><b>Following Factors necessary for selection of hydro power plant site.</b></p> <ol style="list-style-type: none"><li>1. HPP should be located where high rain fall occurs.</li><li>2. A large catchments area must be available to store water ( to store water reservoir )</li><li>3. It should be located as per possible in hilly area to reduces construction cost of dam and water reservoir.</li><li>4. Store water have a reasonable head (Potential Energy).</li><li>5. The catchment area should be such that there are less accumulation of silt and debris.</li><li>6. Large quantity land should be available for water reservoir.</li><li>7. It should be located as far as possible near load center to reduce transmission line cost and losses in it.</li><li>8. Easy access towards the site.</li><li>9. Cost of land should be less.</li><li>10. Solid (Land) should of high bearing capacity to reduce the construction cost of dam and other structure also to make strong foundation to machinery.</li><li>11. Skilled and unskilled man power should be available near the HPP.</li><li>12. The Area should be free from earthquake.</li><li>13. During the construction of dam, it should be possible to divert the stream (river)</li><li>14. It is necessary to see that water is of good quality (i.e.no chemical impurities) because polluted water make cause corrosion</li><li>15. Structures of cultural or historical importance should not be damaged.</li></ol>



e) Draw a block diagram of a Thermal Power Plant.

Ans: block diagram of a Thermal Power Plant:

( 4 Marks)



or equivalent Figure

f) Write the purpose of coal and ash handling unit also write different activities those are carried out in this unit.

Ans: Purpose of coal and ash handling unit :-

( 2 Mark)

- To transport coal from coal storage to power plant.
- A large quantity of ash about 10 to 30 % produced in furnace, the removal of ash from boiler furnace is necessary for efficient combustion.

**Different activities :-**

**1. Coal Handling Activity:-**

( Any one point expected: 1 Mark)

**Coal Delivery:-**

Coal from supply point (mines) is delivered to TPP by dumper or railway or in case of power plant, which are located near sea-shore are delivered by ship.

**Coal unloading:-**

It is done by machinery not manually. e.g. With the help of rotary car dumper or crane etc.



**Coal Storage:**

It is desirable that sufficient quantity of coal should be store at generating station. Because large quantity of coal is required for generation.

There are two types of storage:

1. Outdoor storage (Dead storage)
2. Indoor storage (live storage)

**Preparation of coal:**

- In the plant coal is crushed into small pieces with the help of crusher and breaker. The coal is crushed to 2.5 cm. or less.
- Then it is cleaned by passing forced air to remove the dust contain.
- Moisture is removed with the help of dryer. The moisture content must be less than 2% after drying operation.
- This coal is passed through magnetic separator to separate the iron particles mixed in it.
- Now, coal is passed to pulverizing mill.

**Coal Weighing:**

Before sending pulverized coal to the furnace, its weight is taken.

**2. Ash Handling Activity:-**

**( Any one point expected: 1 Mark)**

Handling of ash coming out from furnace is a problem because.

- Ash is too hot.
- It is dusty.
- It contains some poisonous gases

Hence before handling it is desirable to quench the ash due to following reasons.

- It reduces temperature of ash.
- It reduces dustiness.

**Handling of ash includes:**

- Removal of ash from furnace.
- Load on conveyer belt.
- Deliver to the space where it can be disposed off.

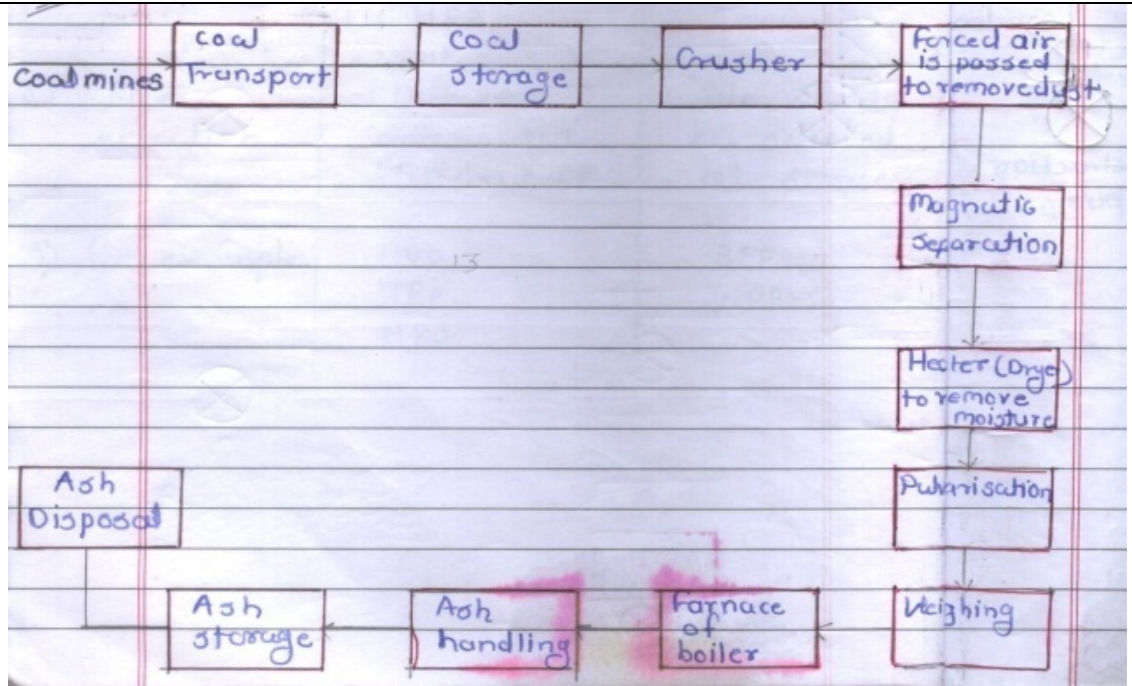
**Various methods of disposal of ash:**

- Mechanical system.
- Pneumatic system.

**OR**

(STUDENTS MAY DRAW FOLLOWING FLOW DIAGRAM)

**Coal And Ash Cycle :-**

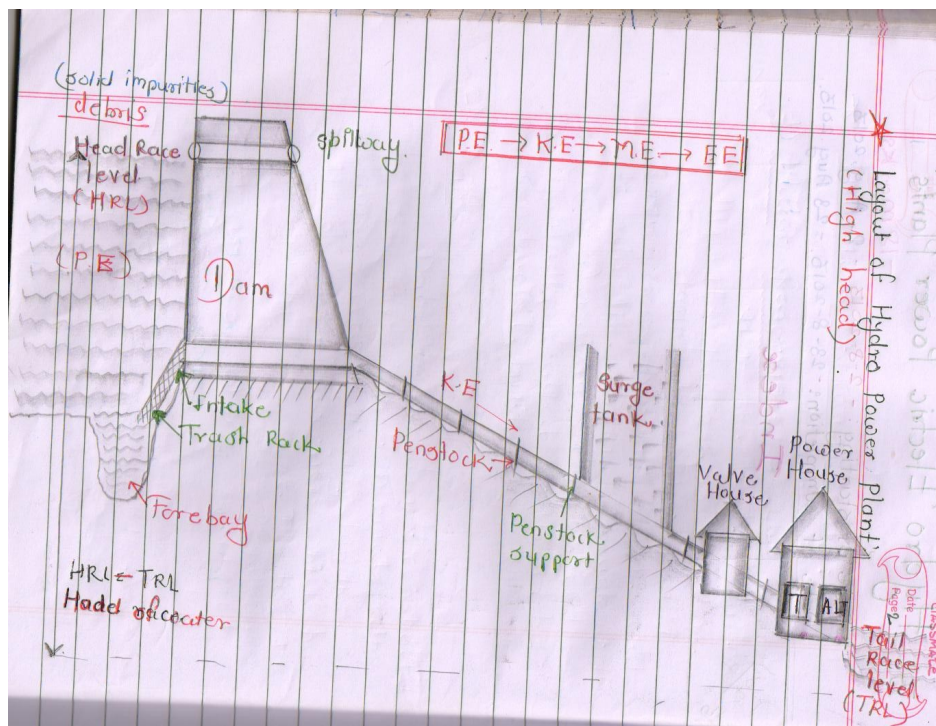


**Q.3** Attempt any FOUR of the following **16 Marks**

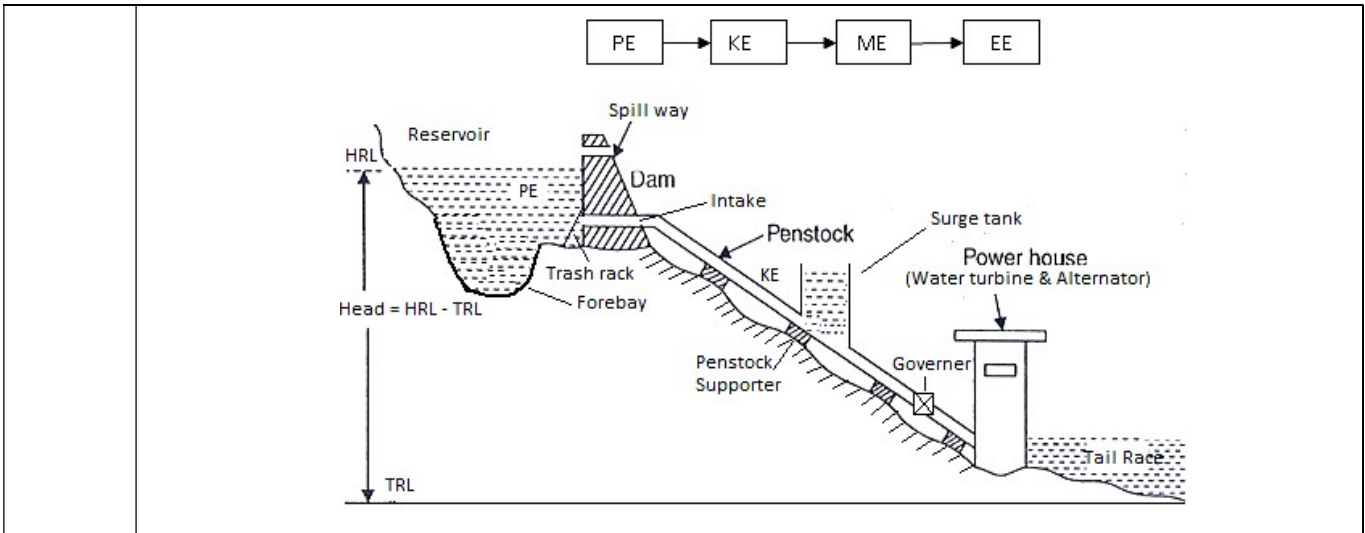
a) Draw a block diagram of a Hydroelectric Power Plant.

Ans: Block diagram of a Hydroelectric Power Plant:

**(4 Marks)**

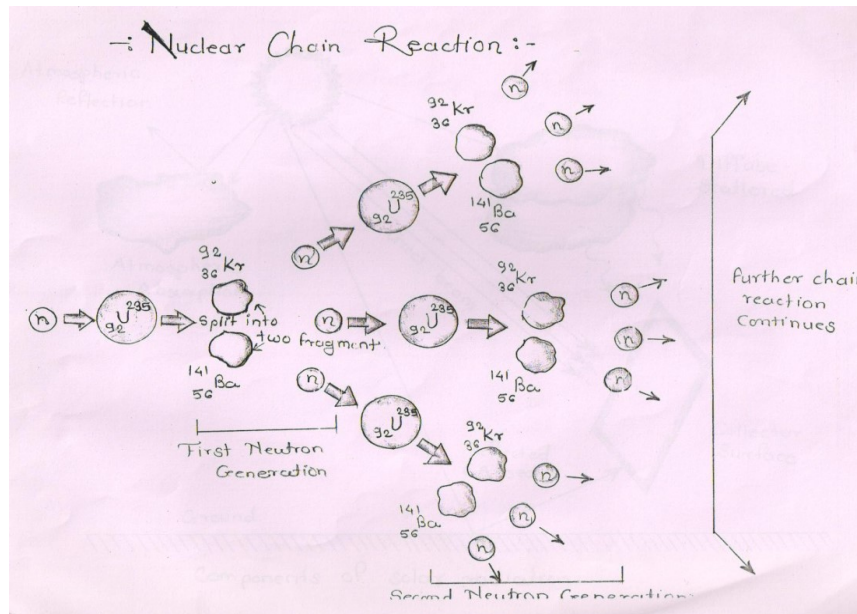


or equivalent Figure



b) Explain the nuclear chain reaction in a Nuclear Power Plant.

Ans: Figure of Chain Reaction: (Figure:2 Mark & explanation:2 Mark, Total: 4 Marks)



Explanation for Chain Reaction:

When nuclear fuel  $\text{U}^{235}$  or  $\text{Pu}^{239}$  when strikes by a slow neutron in nuclear reactor than it under goes nuclear reaction at that time ;

- Huge amount of heat energy is liberated and
- Two or three neutron are produced
- $\alpha, \beta, \& \gamma$  rays are produced





➤ Beryllium & krypton are also produced.

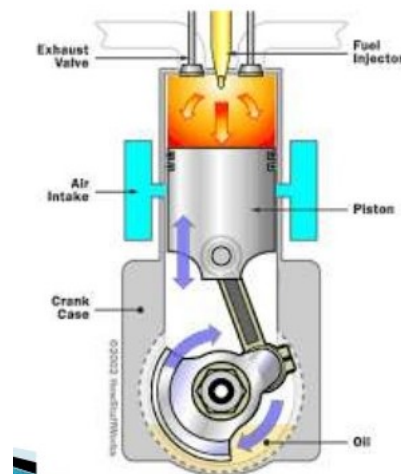
Due to two or three neutron chain reaction is continuous till most of the original nuclei in the given sample are fissioned is called as chain reaction.

A chain reaction will continue till most of the original nucleus in the given sample is fission out.

c) Explain the working of two stroke diesel engine with the help of neat diagram.

Ans: Neat Diagram of Two stroke Diesel Engine:

(Figure:1 Mark & Explanation:3 Mark, Total: 4 Marks)



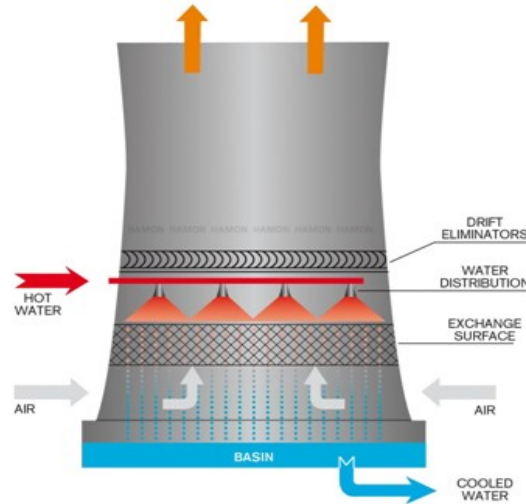
OR Equivalent figure

**Working of Two Stroke Diesel Engine:**

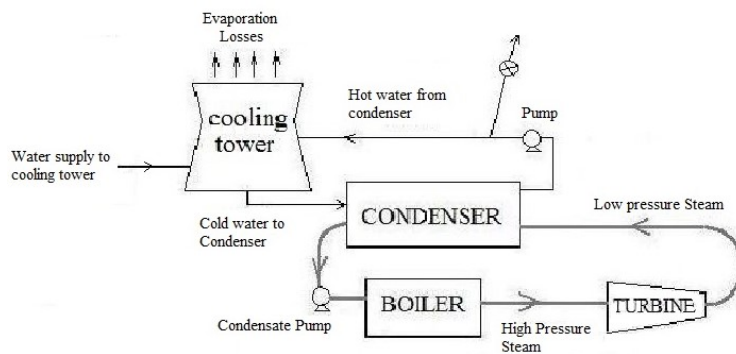
- In case of 2 stroke diesel engine all the 4 operations are completed with 2 strokes of the piston or during one revolution of the crank shaft.
- Intake and compression stroke are completed during the forward travel of piston.
- The power (expansion) and exhaust stroke are completed during the travel of the piston in backward direction.

d) Draw and explain the working of cooling tower in a Thermal Power Station.

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



OR



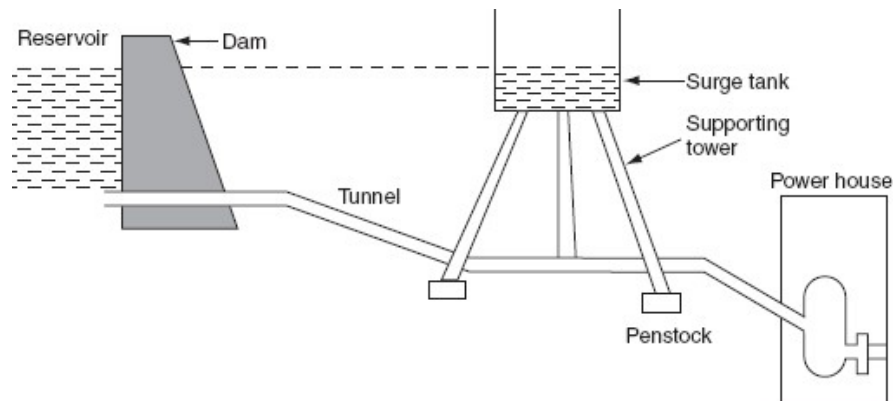
or equivalent figure

- **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



e) Draw the function of each of following elements in Hydroelectric Power Plant  
(i) dam, (ii) Surge tank.

Ans:



i) Dam: -

( 2 Mark)

Dam is a barrier constructed across river in a normal path dam serves following function

- It develops (Create) reservoir which has a capacity to store water.
- It increases storing capacity of water reservoir.
- It helps to increase the working head of water.

Dam is very expensive and the most important part of HPP.

ii) Surge tank :-

( 2 Mark)

A surge tank is the small reservoir or tank. It is open at the top. It is installed near Valve house of turbine.

- It avoids water hammer effect when load on turbine reduces. (It stores immediately the rejected water.
- It avoids cavity effect when load on turbine increases. (It supply immediately the water)

f) State types of radioactive waste generated in a Nuclear Power Station. Explain the methods employed for their disposal.

Ans: ➤ Types of radioactive waste:

( 1 Marks)

The waste produced in nuclear power plant is in the form of solid, liquid & gases,



**1. Solid Waste Disposal:-**

**( 1 Marks)**

- Solid wastes removed from the reactor are very hot and radioactive.
- Solid waste is filled in a sealed container.
- And is kept under water for 5 to 10 years under supervision to 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.

OR

- Solid waste is filled in a sealed container and is disposed off away from sea shore.
  - OR
- Many times old and unused coal mines, salt mines, can be used for waste disposal

**2. Liquid Waste Disposal:-**

**( 1 Marks)**

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

**3. Gaseous Waste Disposal:-**

**( 1 Marks)**

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

OR

**Spent fuel storage:**

**( 2 Marks)**

- The spent fuel assemblies removed from the reactor are very hot and radioactive.
- Therefore the spent fuel is stored under water, which provides both cooling and



	<p>radiation shielding.</p> <ul style="list-style-type: none"><li>➤ After a few years, spent fuel can be transferred to an interim storage facility.</li><li>➤ This facility can involve either wet storage, where spent fuel is kept in water pools, or dry</li><li>➤ Storage, where spent fuel is kept in casks.</li><li>➤ Both the heat and radioactivity decrease over time.</li><li>➤ After 40 years in storage, the fuel's radioactivity will be about a thousand times lower than when it was removed from the reactor)</li></ul> <p><b><u>Spent fuel and HIGH level waste disposal :</u></b> <span style="float: right;"><b>( 2 Marks)</b></span></p> <ul style="list-style-type: none"><li>➤ Spent nuclear fuel or high level waste can be safely disposed of deep underground, in</li><li>➤ Stable rock formations such as granite, thus eliminating the health risk to people and the environment.</li><li>➤ The first disposal facilities will be in operation around 2020.</li><li>➤ Waste will be packed in long-lasting containers and buried deep in the geological formations chosen for their favorable stability and geochemistry, including limited water movement.</li><li>➤ These geological formations have stability over hundreds of millions of years, far longer than the waste is dangerous.</li></ul>
<b>Q.4</b>	<b>Attempt any FOUR of the following</b> <span style="float: right;"><b>16 Marks</b></span>
<b>a)</b>	<b>State the advantages of Hydro Power Plant.</b>
<b>Ans:</b>	<p><b>Advantages of Hydroelectric power plant:-</b></p> <p style="text-align: center;"><b>( Any Four advantages are expected: 1 Mark each, Total 4 Marks)</b></p> <ol style="list-style-type: none"><li>1. There is no air pollution and other environmental problems.</li><li>2. The fuel (water) is available freely.</li><li>3. No fuel transportation cost so; there is no necessity of fuel handling equipment.</li><li>4. No treatment on fuel is required.</li><li>5. No fuel waste is produced (like ash) so, no waste disposal problem.</li><li>6. Fuel can be used again and again. ( Renewable energy sources)</li><li>7. Generating cost is less and reduces day by day.</li><li>8. Power plant can be put into service immediately.</li><li>9. It saves fossil fuels (coal diesel oil etc.) which are limited available which can be used for other purposes.</li></ol>

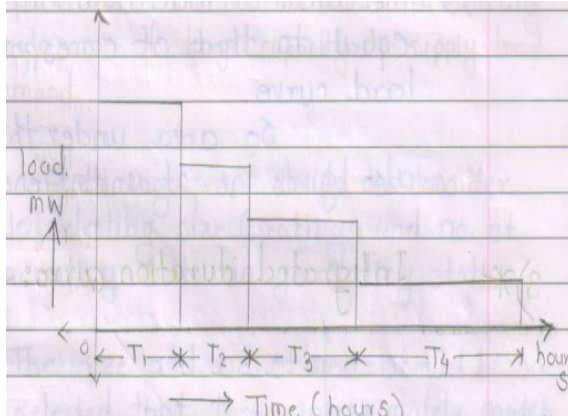


	<ol style="list-style-type: none"><li>10. Less man power is required per MW so, running cost is less.</li><li>11. Layout is simple. Auxiliaries are considerably less than those in the case of a thermal power station.</li><li>12. Power generation can be controlled quickly &amp; rapidly without any difficulty. (By simply controlling flow of water)</li><li>13. There are no standby losses.</li><li>14. Efficiency of plant is highest (above 97%) and does not change with age.</li><li>15. Operating &amp; maintenance cost are very low.</li><li>16. The life of plant is longest.</li><li>17. In addition to generation of electric energy H.P.P. is also useful for supply of drinking water, supply of water for irrigation purpose and it control the flood also.</li><li>18. Since, hydroelectric stations are situated far away from populated areas so, the cost of the land is low.</li><li>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.</li><li>20. It is very neat &amp; clean plant.</li></ol>
<b>b)</b>	<b>Explain the use of Diesel Power Plant as captive power.</b>
Ans:	<p style="text-align: center;"><b>(Any four points expected 1 Mark each point, Total 4 Marks)</b></p> <p><b>Diesel power plant is used as a captive power plant because :-</b></p> <ol style="list-style-type: none"><li>1. It can be put into service immediately.</li><li>2. Such power plant quickly responses for variable load</li><li>3. The design and layout of Diesel electric P.P is simple.</li><li>4. It requires less space.</li><li>5. Time required for complete erection of diesel power plant is less.</li><li>6. Such plants can be located at any place.</li><li>7. It requires less space for fuel storage.</li><li>8. It is free from ash handling problem.</li><li>9. It requires less quantity of water for cooling.</li><li>10. No standby losses.</li></ol>



c) Explain load duration curve with neat diagrams.

Ans: Diagram of load duration curve: (Figure : 2 Mark & Explanation: 2 Mark)



OR



**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:

1. It shows for how long hours a particular load exists.
2. It helps to determine distribution of load between different generating set.
3. 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) Discuss the special features of turbo-alternator used in a Thermal Power Station.

Ans: (Any four features are expected 1 Mark each, Total 4 Marks)

**Special features of a turbo alternator used in TPS:**

**Special Futures:**

- 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.



	<ul style="list-style-type: none"><li>➤ Construction of rotor is cylindrical type.</li><li>➤ Numbers of poles to alternator are two or four.</li><li>➤ <b>Alternator is smaller in diameter and longer in axial length.</b></li><li>➤ It is robust in construction.</li><li>➤ 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.)</li><li>➤ Cooling is necessary to improve the performance of alternator. Cooling system may be air cooled or hydrogen cooled.</li><li>➤ Standard rating of turbo alternator is 125, 200, 300 and 500 M watt and Maximum rating of turbo alternator is 500 M watt.</li><li>➤ Various protections are provided to alternator.<ul style="list-style-type: none"><li>• Over voltage and under voltage protection.</li><li>• Over frequency under frequency protection.</li><li>• Over load protection.</li><li>• Over temperature protection</li></ul></li></ul>
e)	<b>Describe the fuel system and exhaust system of a Diesel Power Station.</b>
Ans:	<p><b><u>Fuel system:</u></b> <span style="float: right;"><b>( 2 Marks)</b></span></p> <p>It supplies fuel to engine for combustion purpose. It consists of</p> <ul style="list-style-type: none"><li>➤ <u>Fuel Pump:</u> - It supplies fuel to engine for combustion purpose.</li><li>➤ <u>Strainer:</u> - Are provided to remove suspended impurities and to supply clean fuel to engine.</li><li>➤ <u>Fuel Injector:</u> - It injects fuel in engine cylinder at the end of compression stroke.</li><li>➤ <u>Heaters:</u> - Are provided to heat the coil especially during winter season</li></ul> <p><b><u>Exhaust system:</u></b> <span style="float: right;"><b>( 2 Marks)</b></span></p> <p>This system is provided to discharge the engine exhaust (smoke) to the atmosphere outside the building. It consists of ;</p> <ul style="list-style-type: none"><li>➤ <u>Silencer:</u> - It is provided to reduce noise.</li><li>➤ <u>Muffler:</u> - It is provided to exhaust pipe to reduce pressure in exhaust line and eliminate most of the noise.</li><li>➤ <u>Chimney:</u>- To exhaust gases in the atmosphere as high as possible.</li></ul>

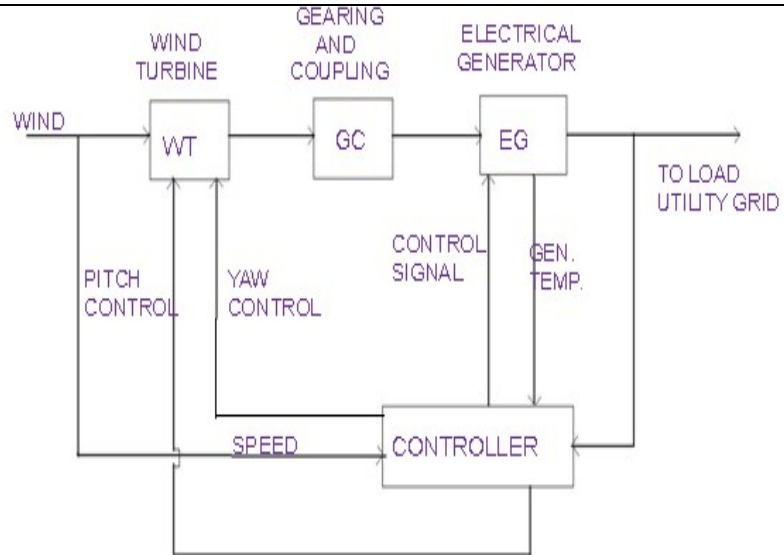




f)	"Running & maintenance cost of Thermal Power Station is more than Hydro Power Station." Justify the statement.
Ans:	<b>Reason for Statement:</b> <span style="float: right;"><b>( 4 Marks)</b></span> <p>In thermal Power plant in addition to turbine &amp; alternator following auxiliaries' are required which are not required in hydroelectric power station. Hence 'Running and maintenance costs of thermal power station are more than hydro power stations.</p> <p style="text-align: right;"><b>( Any four points are expected)</b></p> <ol style="list-style-type: none"><li>1. Coal conveyer</li><li>2. Pulverizer</li><li>3. Stoker</li><li>4. Boiler</li><li>5. Furnace</li><li>6. Economizer</li><li>7. Air preheater</li><li>8. Super heater</li><li>9. Re-heater</li><li>10. H.P and L.P. feed water heater</li><li>11. Draught System<ol style="list-style-type: none"><li>a) Forced Draught fan (FDF)</li><li>b) Induced Draught fan (IDF)</li></ol></li><li>12. Condenser</li><li>13. Cooling tower</li><li>15. Chimney or stack</li><li>16. Precipitator (dust collector) (<i>Electro-static precipitator</i>)</li><li>17. Ejector</li><li>18. Deaerator</li><li>19. Water treatment plant</li></ol>
Q.5	<b>Attempt any FOUR of the following</b> <span style="float: right;"><b>16 Marks</b></span>
a)	<b>Explain the role of control rod in a nuclear reactor. State any two materials for control rod.</b>
Ans:	<b>(Role of Control Rod:2 Mark &amp; Any Two Materials Name expected: 1Mark each, Total: 4 Marks)</b> <b>Role of Control Rod :</b> <p>Fuction of contrl rod is to be regulate fission process by absorbing the neutron. The control rod is inserted into the reactor core from top of the reactor vessel.</p> <p style="text-align: center;"><b>OR</b></p>

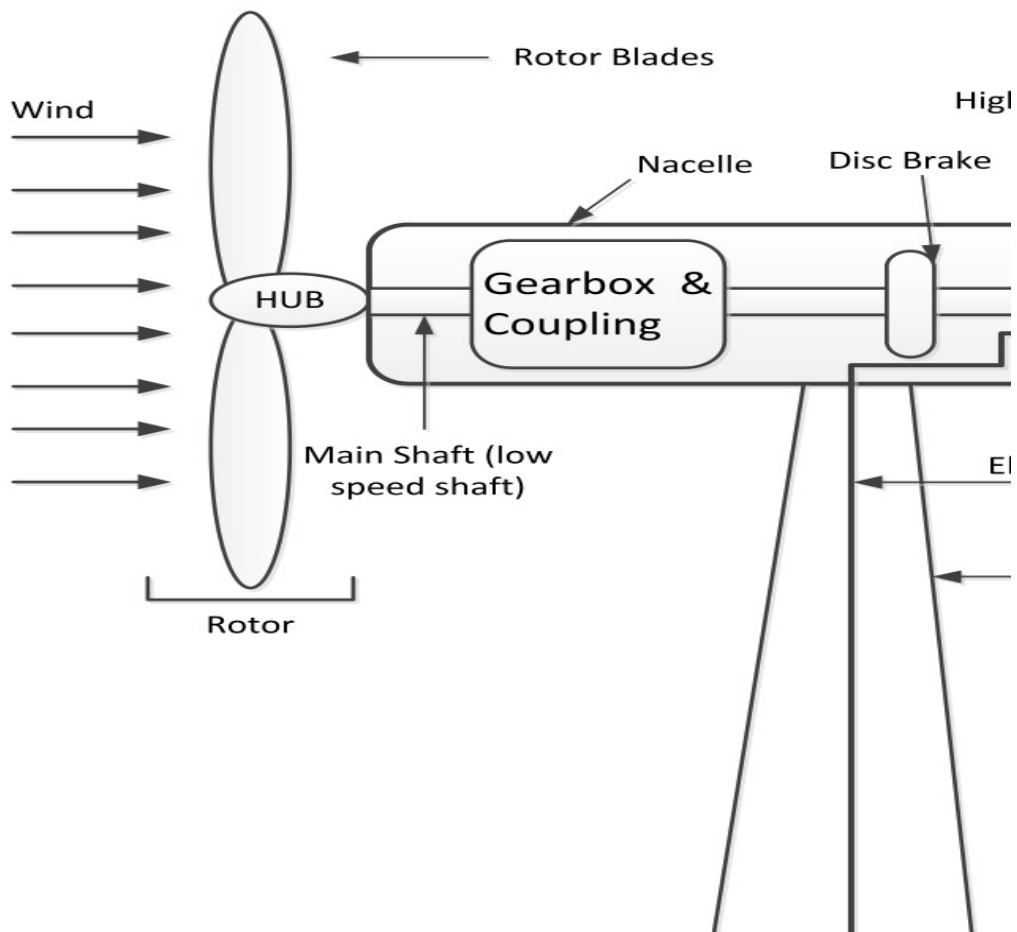


	<p>The function of control rod is to control the chain reaction in reactor core by adjusting its height.</p> <p><b>Following are the Materials used for control rod:</b></p> <p><u>Material used for control rod</u></p> <ul style="list-style-type: none"><li>i) Boron</li><li>ii) Cadmium</li><li>iii) Hafnium</li></ul>
<b>b)</b>	<p><b>State the principle of Solar cell and give its ratings.</b></p>
<b>Ans:</b>	<p><b><u>Principle of Solar Cell:-</u></b> ( Principle : 2 Mark &amp; its rating : 2 Marks)</p> <p>Solar cell operates on principle of Photo-voltaic effect</p> <p><u>Solar cell works in following steps:</u></p> <ul style="list-style-type: none"><li>➤ When sun light (photon) is absorbed by the semiconductor material the cell produces two types, -<ul style="list-style-type: none"><li>▪ A negatively charged electron and</li><li>▪ Positively charged holes are created due to photovoltaic effect.</li></ul></li><li>➤ Negatively charged (-) electrons gather around the N-type semiconductor while</li><li>➤ Positively charged (+) electrons gather around the P-type semiconductor.</li><li>➤ When you connect loads such as a light bulb, electric current flows between the two electrodes</li></ul> <p><b><u>Rating of Solar Cell:</u></b></p> <ul style="list-style-type: none"><li>➤ Each solar cell generates = 0.5 to 1V DC</li><li>➤ And Current density = 20 to 40A /mm<sup>2</sup> i.e. 0.8 Amp</li></ul>
<b>c)</b>	<p><b>Draw Wind Power Plant diagram and show main components of Wind Power Plant.</b></p>
<b>Ans:</b>	<p><b>Diagram of wind power plant :</b> ( 4 Marks)</p>



OR

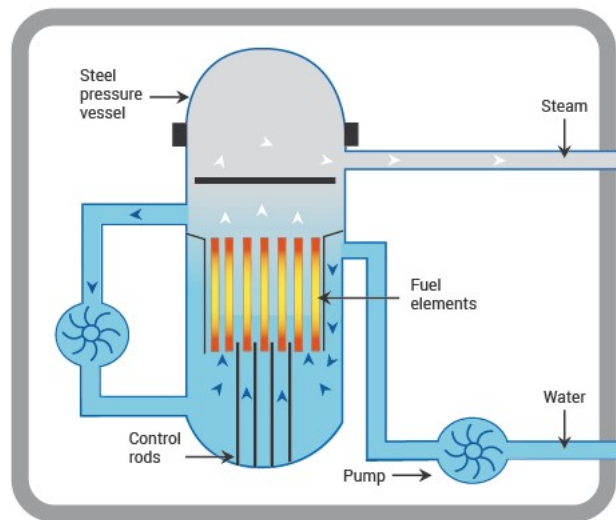
### Layout of Wind Power



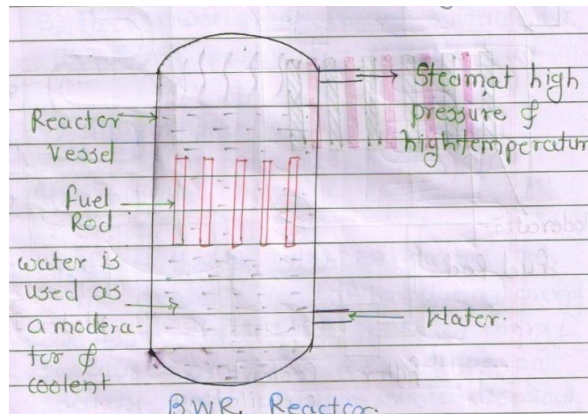
**d) Explain working of boiler water nuclear reactor.**

**Ans: Diagram of boiler water nuclear reactor:**

**( Diagram: 2 Mark, Explanation: 2 Mark, Total 4 Mark)**



**OR**



**OR Equivalent figure**

It is explain on following points

- In BWR the steam is generated in the reactor itself. There is no need of heat exchanger.
- Fuel used is Enriched Uranium.
- Moderator used is light or heavy water.
- Coolant used is light or heavy water.
- Temperature obtain is  $280^{\circ}\text{C}$ .
- Efficiency is 33 %.
- Steam pressure is  $68 \text{ Kg/cm}^2$



e)	<b>Classify Hydro Power Plant on the basis of load &amp; head available.</b>
Ans:	<p><b>Classify hydro power plant on the basis of Load supply : (2 Mark)</b></p> <ol style="list-style-type: none"><li>1. Base load Power plant</li><li>2. Peak load power plant</li><li>3. Pumped storage for peak load plant</li></ol> <p><b><u>Classify hydro power plant on the basis of Head of Water: (2Mark)</u></b></p> <ol style="list-style-type: none"><li>1. Very high head power plant</li><li>2. High head power plant</li><li>3. Medium head power plant</li><li>4. Low head power plant</li></ol>
f)	<b>Explain the procedure for disposal of Nuclear Waste with suitable diagram.</b>
Ans:	<p><b>(Diagram: 1 Mark, Any Three points are expected, 1 Mark each, Total 4 Marks)</b></p> <p><b>Nuclear Waste with suitable diagram:</b></p> <div data-bbox="491 1227 1273 1890" data-label="Diagram"><pre>graph TD; A[Radioactive Waste] --&gt; B[Pre-Treatment]; B --&gt; C[Treatment]; B --&gt; D[Exempt Waste]; C --&gt; E[Conditioning]; C --&gt; F[Nuclear material for recycle / reuse]; E --&gt; G[Disposal]</pre><p>Following the procedure adopted for the disposal of Nuclear Waste:</p><p>➤ <u>Nuclear waste disposal in nuclear power station:</u></p></div>



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.



	<ul style="list-style-type: none"> <li>Then passed through radiation monitoring system.</li> <li>In this system concentration of radioactive material are measured.</li> <li>If it is safe then released to atmosphere at high level through large height chimney.</li> </ul>	
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**Q.6**      **Attempt any FOUR of the following**      **16 Marks**

a) **List types of solar cells with their efficiencies.**

Ans: **Types of solar Solar cells:** **(Types: 2 Mark)**

1. P-N Homo-junction.
2. P-N Hetro Junction
3. Hetro Junction –Homo Junction
4. MIS (Metal Insulator semiconductor)
5. SIS (Semiconductor insulator semiconductor)

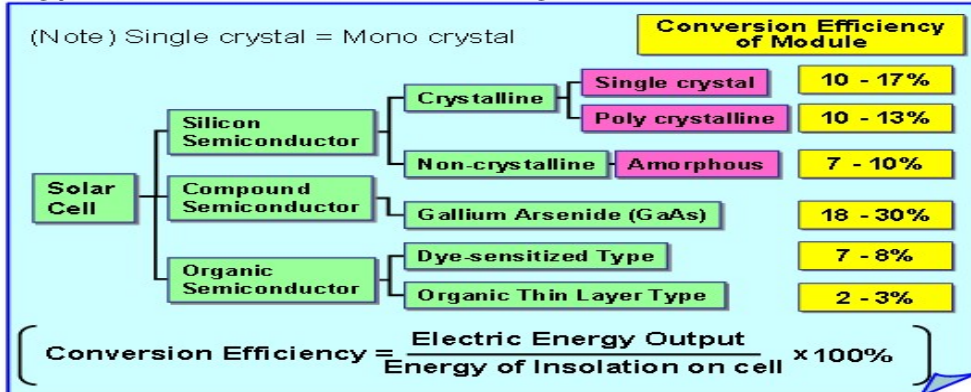
**Efficiencies of a solar cell:-** **(2 Mark)**

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

**1-2. Various type of PV cell**

• **Types and Conversion Efficiency of Solar Cell**





MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION  
(Autonomous)  
(ISO/IEC-27001-2005 Certified)

SUMMER– 2019 Examinations

Subject Code: 17324

Model Answer

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<b>b)</b>	<b>Distinguish between base and peak load.</b>																														
Ans:	<b>( Any four points expected : 1 Mark each, Total 4 Marks)</b>																														
	<table border="1"><thead><tr><th>Sr.No.</th><th>Base load</th><th>Peak load</th></tr></thead><tbody><tr><td>1</td><td>The power plant which supplies base load of load curve is known as base load plant</td><td>The power plant which supplies peak load of load curve is known as peak load plant</td></tr><tr><td>2</td><td>Generating capacity of such power plant is high</td><td>Generating capacity of such power plant is medium or low</td></tr><tr><td>3</td><td>Firm generating capacity of such power plant is High</td><td>Firm generating capacity of such power plant is low</td></tr><tr><td>4</td><td>Such power plant working hours is 24 hours</td><td>Such power plant working hours are only during peak load hours</td></tr><tr><td>5</td><td>Load factor of such power plant is high</td><td>Load factor of such power plant is low</td></tr><tr><td>6</td><td>Utilization factor of such power plant is more.</td><td>Utilization factor of such power plant is less.</td></tr><tr><td>7</td><td>Generally low cost of generation per unit are selected as base load plant</td><td>Generally high cost of generation per unit are selected as peak load plant</td></tr><tr><td>8</td><td>Both quick &amp; more starting time power plant can be selected as a base load plant</td><td>Quick starting time power plant are selected as a peak load plant</td></tr><tr><td>9</td><td>Large capacity hydro, thermal, nuclear power station</td><td>Small capacity storage hydro, pumped storage hydro, gas, diesel power station.</td></tr></tbody></table>	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.
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<b>c)</b>	<b>State any four advantages and any four limitations of wind energy.</b>																														
Ans:	<b>Advantages of wind energy system:</b> <b>( Any Four point Expected:1/2 each, Total: 2 Mark)</b> <ol style="list-style-type: none"><li>1) Fuel is freely available.</li><li>2) Wind energy is inexhaustible.</li><li>3) There is no air pollution.</li><li>4) No fuel transportation cost.</li><li>5) No space is required to store fuel.</li><li>6) No need on treatment on fuel.</li><li>7) No waste disposal cost and problem.</li><li>8) Less manpower is required per MW.</li><li>9) Layout is simple.</li></ol>																														





- 10) Time required for completion of power plant project is less.
- 11) Space required is less and space around the tower can be utilized for farming or storage.
- 12) It works automatically i.e. wind turbine operates automatically.(Not required to start WPP)
- 13) Technology is simple and robust.
- 14) Generating cost per unit is less and is goes on decreases day by day.
- 15) Maintenance cost is less.
- 16) Type of source is renewable.

**Following are the Limitations of wind energy :**

**( Any Four point Expected:1/2 each, Total: 2 Mark)**

1. Initial cost per MW is high.
2. The source of power (wind) is unsteady and unreliable.
3. No firm generating capacity.
4. In case of low wind, power cannot be generated.
5. Its efficiency is low (20% -30%).
6. There is limitation on site selection.
7. Transportation cost of wind tower and accessories is high.
8. It disturbs load traffic during transportation of heavy wind tower and accessories.
9. Installation cost of wind tower is high and difficult (because of WPP are generally in hilly area and transportation of heavy crane and other equipments is difficult to reach up to the site.)
10. Wind turbine produces noise.
11. Wind power systems have a relatively high overall weight.

**d) Explain why Nuclear Power Plants are preferred as base load plants.**

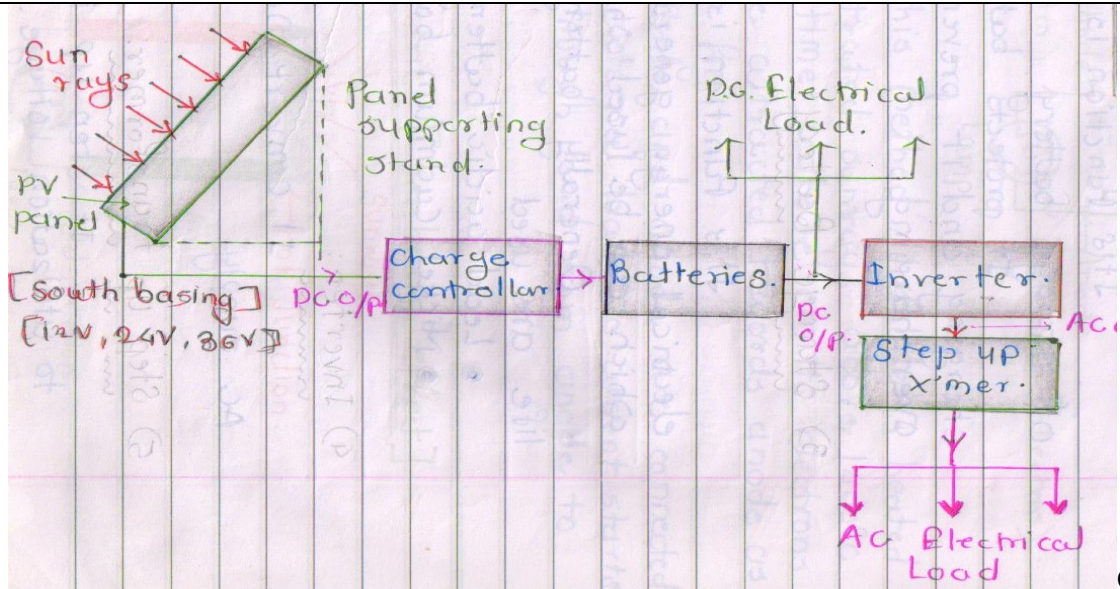
Ans: **Because of following points Nuclear power plant used as base load power plant:-**

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

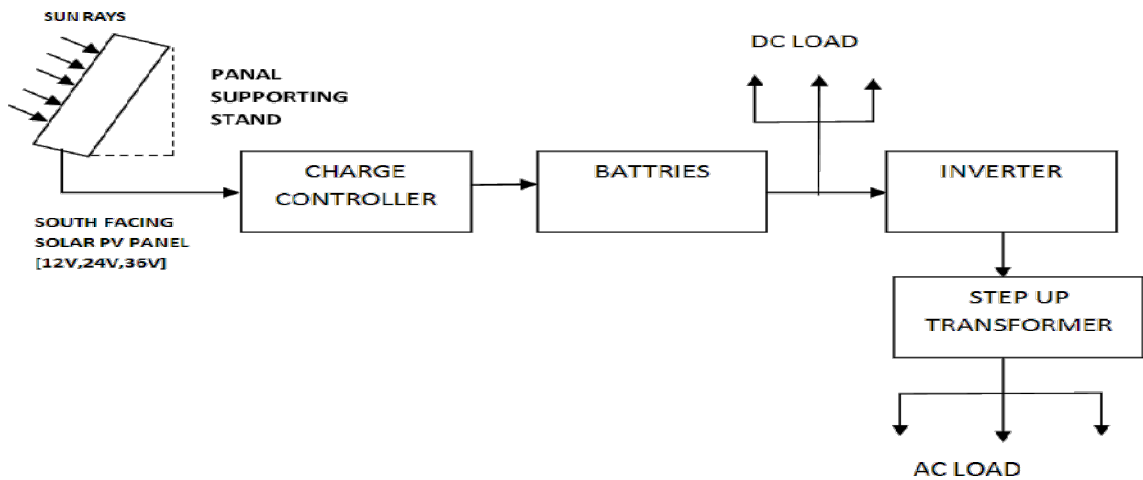
1. Nuclear power plants is very economical for producing bulk amount of electric power
2. Nuclear power plant is reliable in operation.
3. Nuclear power plant are not affected by adverse weather conditions.
4. Nuclear energy is outstanding as compare to any other type of energy sources.
5. Large amount of nuclear fuel is available in nature .
6. Nuclear fuels do not produce carbon dioxide or sulfur dioxide so it produces less air pollution.



e)	<p><b>The maximum demand of a power plant is 100 Mw. The capacity factor is 0.6 &amp; Utilisation factor is 0.81 find (i) Load factor (ii) Plant capacity (iii) Reserve capacity (iv) Annual energy production</b></p>
Ans:	<p><b>Solution-</b></p> <p><b>Given data-</b> M.D.=100 MW,      U.F.= 0.81,      C.F.=0.6</p> <p style="text-align: center;">Find- the reserve capacity of the plant</p> <p><b>Capacity factor = load factor x utilization factor</b></p> <p>i) ∴ Load Factor = <math>\frac{\text{Capacity factor}}{\text{utilization factor}}</math> ..... (1/2 marks)</p> <p style="text-align: center;">∴ Load factor = <math>\frac{0.6}{0.81}</math></p> <p style="text-align: center;">∴ Load factor = 0.74 ..... (1/2 marks)</p> <p>ii) Plant capacity = <math>\frac{\text{maximum demand}}{\text{utilization factor}}</math> ..... (1/2 Marks)</p> <p style="text-align: center;">∴ Plant capacity = <math>\frac{100}{0.81}</math></p> <p style="text-align: center;">∴ Plant capacity = 123.45 MW ..... (1/2 Marks)</p> <p>iii) Reserved capacity = Plant capacity - Maximum demand ..... (1/2 Marks)</p> <p style="text-align: center;">= 123.45 – 100</p> <p style="text-align: center;">= <u>23.45 MW</u>..... (1/2 Marks)</p> <p>iv) Annual Energy production:</p> <p style="text-align: center;">= M.D x L.F. x 8760..... (1/2 Marks)</p> <p style="text-align: center;">= 100 x10<sup>3</sup> x 0.74 x 8760</p> <p style="text-align: center;">= 648240 x10<sup>3</sup> KWh..... (1/2 Marks)</p>
f)	<p><b>Draw the functional block diagram of photo voltaic power generating system and explain each block in brief.</b></p>
Ans:	<p><b>Functional block diagram of photo volatic power generating system:</b></p> <p style="text-align: center;"><b>(Block Diagram: 2 Marks &amp; Explanation:2 Marks, Total: 4 Marks)</b></p>



OR



OR Equivalent Figure

**Explanation:**

Solar power plant consists of following components:

**1. Photovoltaic cell panel:**

Its function is to convert sunrays directly into DC electricity.

**2. Battery charge Controller:**

It protects battery from over charging and it prevents battery from over discharging.

In this way it increases life of storage battery. OR A charge controller is needed to ensure the battery is neither over nor under-charged



**3. Storage Battery:**

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

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

1. Lead acidic battery
2. Nickel cadmium battery

**4. Inverter:**

It convert DC supply into AC supply..

**5. Step-up transformer:**

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

-----**END**-----