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 A) Attempt any Ten of the following: ----------20 Marks

a) What is conventional source of energy? State two examples for the same.

Conventional source of energy: These are the sources of energy which are presently used to generate electrical energy which called conventional source of energy.**…… (1 Mark)**

Examples of the conventional energy sources: (Any two Sources expected)

……..…….. (1/2 Mark Each)

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

OR

1. Thermal power plant
2. Nuclear power plant
3. Hydro power plant
4. Diesel power plant

b) State any two advantages of thermal power station. (Any Two expected: 1 Mark to Each)

Advantages-

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.
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. **Overload capacity:-**
   TPS can be work under 25% overloads continuously.
7. **Time required for completion of project:-**
   It is less than hydro power station.

c) Name any two thermal power stations in Maharashtra with their capacity.

(Any Two Expected 1 Mark to Each)

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

d) What is forebay? What is its function?

Meaning of Forebay : …… **(1Mark)**

Forebay is an enlarged body of water at the intake(dam) to store more quantity of water.

Function of forebay: . …… **(1 Mark)**

It is nothing but regulating reservoir. Forebay is stores the rejected water as the load on the turbine decreases & supplies water immediately when load on turbine increases i.e. it is nothing but surge tank for small capacity hydro power station.

e) Write down the capacity in MW and efficiency on full load of Hydro generators.

Following are the some standard ratings of Hydro generators in MW **(1/2 Mark to Each)**
(Note: Any Two Standard Ratings are Expected)

0.2,1,1.2,1.5,4,5,6,7.5,8,10,12,15,16,18,25,34,40,53,60,66,70,80,125,250,500 MW.

Efficiency on full load of Hydro generators-. ……..…… (1 Mark)

High (more than 95%)

f) List out any two nuclear power stations in India with capacity. . (Any Two 1 Mark to Each)

Name of the nuclear power station in India with its installed capacity:

Sr.No.	Name of power station	Location	State	Capacity(MW)	Total Capacity(MW)
1	Tarapur Atomic power station(APS)	Tarapur	Maharashtra	2x 160 2x 540	1400
2	Madras APS	Kalpakkam	Tamilnadu	2x 220	440
3	Madras APS	Kalpakkam	Tamilnadu	1x 500	500
4	Kaiga APS	Kaiga	Karnataka	3x 220	660
5	Kakrapur APS	Surat	Gujrat	2x 220 2x 700	1840
6	Kundankulam APS	Kundankulam	Tamilnadu	2x 1000 2x 1000	4000
7	Narora APS	Narora	U.P.	2x 220	440
8	Rajasthan APS	Pawatbhata	Rajasthan	1x 100 1x 200 4x 220	1180

g) What is nuclear chain reaction?.....…… (2 Mark)

Nuclear Chain Reaction: (Note: Student may write answer in different way also)

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

- 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.

h) Explain captive power generation in brief. . ……..…… (2 Mark)

Captive power generation plant set up by any person **OR** by any co-operative society **OR** association of persons or by industry **OR** group of industries to generate electricity primarily for his own use & sell excess power to state electricity board is known as **captive power generation.**

OR

Advantages of captive power generation: (Any Two points are expected- 1 Mark each point)

i) Transmission losses reduce as generation is nearby load centre.

ii) Reliability of supply increases.

iii) Low tariff than Supply Company.

iv) Surplus energy can be sale easily to other consumers.

v) Power quality is good. (Free from harmonics)

vi) Reduces the load on the grid, thus reduces the need for grid up gradiation.

vii) CPP reduces economic loading on government to built a new power project.

viii) In some industry like textile and paper manufacturing industry steam is require in manufacturing processes. Same steam can be used for generation of electricity. Thus increase efficiency of industry.

i) Compare base load plant with peak load plant on any two points. .

(Any Four points are expected: 1/2 Mark to Each)

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

j) Define the following terms as referred to a power station: i) Maximum Demand ii) Load Factor

i) Maximum Demand:-…… (1 Mark)

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

ii) Load Factor: …… (1 Mark)

The ratio average demand to the maximum demand during a given period is known as load factor.

$$Load\ Factor = \frac{Average\ \ demand}{Maximum\ \ demand}$$ **OR**

$$Yearly\ Load\ Factor = \frac{No.\ of\ units\ (KWH)\ generated\ in\ one\ year}{Maximum\ demand \times Hours\ \ in\ 1\ year\ (8760\ hr)}$$

k) Write down any two disadvantages of nuclear power station.

(Any Two points are expected 1 Marks to Each)

Disadvantages of nuclear power station: (Any two Expected)

1. Capital cost of plant is higher as compare to thermal power plant
2. Maintenance cost of plant is high.
3. The erection & commission of this plant require more technical knowldege staff so cost generation is increases.
4. Spacially trained staff is require to handle the plant which rises the running cost due to high salaries.
5. The fission bi-products are generally redioactive & may cause dengereous amount of radioactive pollution.
6. Disposal of nuclear waste require high cost because they have eithere to be disposed off in a deep trench or sea away from sea-shore to aviod air pollution.
7. The fuel used is expensive.
8. Nuclear power plant not suitable for suppling power to variable load.
9. In case of acciedent there may be explosion (like-atom Bomb) causing extensive damage to the mankind,animals and envirment.
10. Generation Cost per unit is more.

l) Explain Air-intake system of diesel power station in brief. . …… (1 Mark to Each)

Air intake system of diesel power station:

Air intake system is provided to supply air to engine for fuel combustion.

- **Air Filter:** Air filtered is provided to remove dirt and dust from the air to be supplied from the engine.
- **Super charger (boosting):** It is employed to increase the pressure of intake air, above atmosphere to develop more power output.
- In cold season intake air is heated by the heat from exhaust gases before injection.

Q.2 Attempt any Four of the following: ----------16 Marks

a) What is calorific value? Write down calorific value of Bituminous coal and petrol. Also give any two advantages of liquid fuels over solid fuels.

Calorific value: - …… **(2 Mark)**

It means how much heat energy is released per kg/ per liter during combustion process.

Calorific value of Bituminous coal- 23000 to 34000 kj/kg . …… **(1 Mark)**

Calorific value of petrol- 10800 Kcal/Kg. …… **(1 Mark)**

b) What are the points to be considered while selecting site for a steam (Thermal) power station? Explain any four points in details.

(Any four points are expected-1 Mark to Each Point)

Following points are considred while selecting site for thermal power station :-

i) Distance from coal mines :-

The power plant should be near the coal mine ,so that cost of fuel transportation reduces.

ii) 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.

iii) Space availability :-

The power plant should have sufficient large space available for coal storage & ash disposal.

iv) Load Centre :-

Plant should be located near load centre to reduce transmission cost & transmission line losses.

v) Easy acces :-

The site should have easy acces for transportation of machanery, man power, etc

vi) Condition of soil:-

The land should be rocky (Hard murrum) for the better foundation of building and machianry.

vii) 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.

OR

Following Factors are to be considered:-

1. It should locate near coal mine.
2. Sufficient quantity of water should be available.
3. Sufficient large space should be available.
4. It should be located near load centre.
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. A large extent of land is required for the erection of thermal plant. So, the cost of the land has a considerable bearing on the working of a thermal plant. So, the cost of the site should be reasonable.
2. The private land should be as minimum as possible.
3. The operation of a thermal plant requires huge quantities of water. So, it is preferable to have the site near the canal or a river.
4. Facilities should exist for the transport of fuel.
5. The soil should not be too loose or too rocky.
6. The site should be level. There should be no excavation nearby.

7. The site should be far away from the residential localities so as to avoid the nuisance of smoke, noise, etc.
8. Future extensions of the power station should be possible.
9. Sufficient land must be available nearby the power station to build the residential accommodation to the operation and maintenance staff.
10. Ash disposal should not create any problem.
11. To the extent possible, the thermal station should be far away from an aerodrome.
12. If canal or river water is used, it should not be polluted to ensure that the interests of the other users are not affected.
13. The design should be in conformity with the by-laws of the land and the town planning.
14. The interests of national defense must be served.

c) i) Name four different ash handling systems.

ii) Classify dust collectors. What happens to their efficiency when load increases?

i) Name four different ash handling systems.

The various methods for the disposal of ash are as follows **(Four classify :1/2 Mark each)**

a) Hydraulic system.
b) Water Jetting
c) Pnumetic system
d) Mechanical ash handling system.

ii) Dust collectors- . …… (1/2 Mark to Each)

There are two types of dust collectors

i) Mechanical dust collector

ii) Electrical dust collector (electrostatic precipitator)

Effect of load:- …… (1 Mark)

Efficiency decreases as ash generated is more.

d) Classify hydro-electric power plants according to head and explain each type in brief.

Hydro power plants are classified according to head of water as below-…… (1 Mark)

i) Low head power plant (Below 30m)

ii) Medium head power plant (30 to 300 m)

iii) High head power plant (above 300m)

i) Low head power plant (Below 30m) . …… (1 Mark)

- If the available water head is less than 30 m, the plant is called a low-head plant.
- The necessary head is created by construction of a dam or barrage. **OR**

When the available water head is less than 30 m, the plant is called a low-head plant. The necessary head is created by construction of a dam or barrage.

ii) Medium head power plant (30 to 300 m) . …… (1 Mark)

- If the available water head is between 30 and 100 m, the plant is called a medium-head plant.
- Water is led to the turbines from the forebay by the penstocks, which may be steel pipes.
- Forebay also stores the rejected water as the load on the turbine decreases. Francis turbines are normally used. **OR**

If the available water head is between 30 and 100 m, the plant is called a medium-head plant. Water is led to the turbines from the forebay by the penstocks, which may be steel pipes. Forebay also stores the rejected water as the load on the turbine decreases. Francis turbines are normally used

iii) High head power plant (above 300m) . …… (1 Mark)

- If the available head is more than 300 m, the plant is called high-head plant.
- The civil works include a surge tank, the function of which is to meet the sudden changes in the requirement of water caused by the fluctuations in the system load. **OR**

If the available head is more than 300 m, the plant is called high-head plant. The civil works include a surge tank, the function of which is to meet the sudden changes in the requirement of water caused by the fluctuations in the system load.

e) What is i) Fire tube boiler ii) Water tube boiler. Also write their maximum pressure, capacity and one example for each type.

i) Fire tube boiler:

- **Fire tube boiler**: In fire tube boilers hot gases are passed through the tubes and water surrounds these tubes. **(1/2 Mark)**
- **Maximum pressure:** High pressures of steam are not possible, maximum pressure that can be attained is about17.5kg/sq-cm **(1/2 Mark)**
- **Capacity:** A capacity of about 9,000 kg -15000 kg (9 ton-15 ton) of steam per hours**.** **.....(1/2 Mark)**
- **Example:** Where low pressure, low temperature, low capacity steam is required **(1/2 Mark)**

ii) Water tube boiler:

- **Water tube boiler:** In these boilers water is inside the tubes and hot gases are outside the tubes. They consist of drums and tubes. **(1/2 Mark)**
- **Maximum pressure:** We can attain pressure as high as 125 kg/sq-cm **(1/2 Mark)**
- **Capacity:** A capacity of about 10,00,000kg (1000 ton) per hour of steam per hours.…… **…….(1/2 Mark)**
- **Example:** Where high pressure, high temperature, high capacity steam is required (e.g. thermal power station) **(1/2Mark)**

f) State the function of following components of a thermal power station.
(1 Mark to each component)

i) Economizer: The function of economizer is to increase the temperature of feed water (With help of absorbing temperature from flue gases) before entering the water in boiler.

ii) Air preheater: In Air preheater temperature of intake air used for combusion is increased with the help of absorbing temperature from flue gases.

iii) Alternator: Its function is to convert mechanical power into electrical power.

iv) Condenser: function of condenser is convert exhaust steam again into water by reducing its temperature with the help of cold water.

OR

Exhaust steam from turbine is passed to condenser where it is again converted into water by reducing temperature of steam with the help of cold water.

Q.3) Attempt any Four of the following: ----------16 Marks

a) State any four advantages and any two disadvantages of hydro-electric power station.

- **Advantages of Hydroelectric power plant:- (Expected Any four Advantages)**
  (Any Four Expected: 1/2 Mark to each point)

1) There is no fuel cost as water is available in nature.
2) There is no fuel transportation cost.
3) There is no necessity of fuel & ash handling equipment.
4) There is no air pollution.
5) It is very neat & clean plant.
6) Operating & maintenance cost are very low.
7) H.P.P can be put into service immediately.
8) There are no standby losses.
9) Efficiency of plant is highest and does not change with age.
10) Power generation can be controlled quickly & rapidly without any difficult.
11) This plant is suitable for supplying power to variable load.
12) By controlling discharge of water precisely, constant speed & frequency can be maintained.
13) The life of plant is longest.
14) Generation cost per unit (KWH) is lowest.
15) In addition to generation of electric energy H.P.P. is also useful for supply of drinking water, supply of water for irrigation and control the flood.

- **Disadvantages of hydroelectric Power Stations:-** **(Expected any two point -1 Mark each)**

1. High capital cost due to construction of dam.
2. It depends on nature as it require huge amount of water which is store during rainy season.
3. Firm power (Output) is totally depends on monsoon.
4. It takes long time for complete erecting of power plant.
5. It requires large area (catchment) area for storage of water.
6. As sites are away from load centre, so cost of transmission and losses in it are more.
7. There is limitation to select the site of HPP because of their requirements.

b) How will you dispose nuclear waste? Explain the method for solid, liquid and gaseous waste.

➢ **Nuclear waste disposal in nuclear power station**…….. **(1 Mark)**

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:-** ..... **(1 Mark)**

Solid wastes are diluted to a sufficient level before disposed off. These can be disposed as below:

The solid waste is buried deeply in the ground by making trench, However, the area must be away from populated area and there is less rain fall in that area.

OR

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

OR

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

➢ **Liquid Waste Disposal:-** ..... **(1 Mark)**

The liquid waste is diluted to a sufficient level with large quantity of water and then released in the ground. However land should be unused and it should be away from populated area.

OR

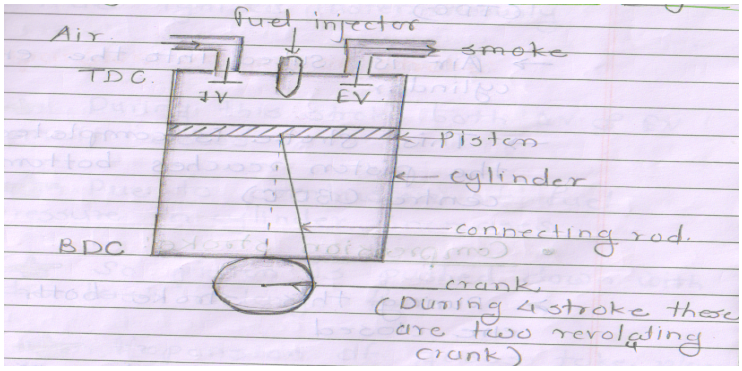
The liquid waste after dilution is sealed in container and is disposal off into the sea several Km away from sea-shore.

➢ **Gaseous Waste Disposal:-** ..... **(1 Mark)**

Gaseous waste are generally diluted with air and passed through filter then released to atmosphere at high level through large height chimney

c) Describe the working of four stroke diesel engine.

Working of four stroke diesel engine is as below:-



i) First stroke suction- …….....…….....**(1 Mark)**

- Inlet valve (IV) and exhaust valve (EV) closed.
- Air is taken inside the cylinder under pressure so piston is ready to move down from top dead centre (TDC).
- Air is sucked into the engine cylinder.
- This stroke is completed when the piston reaches bottom dead center.

ii) Second stroke compression- ……...…….....**(1 Mark)**

- During this stroke both IV & EV are closed.
- During this stroke piston starts moving upward from the BDC position.
- As the piston moves up the air compressed to a high pressure (60 bar) and temperature (600^{o}c)
- Just before the end of compression stroke a fine spray of diesel is injected into the cylinder.
- Fuel ignites instantaneously.

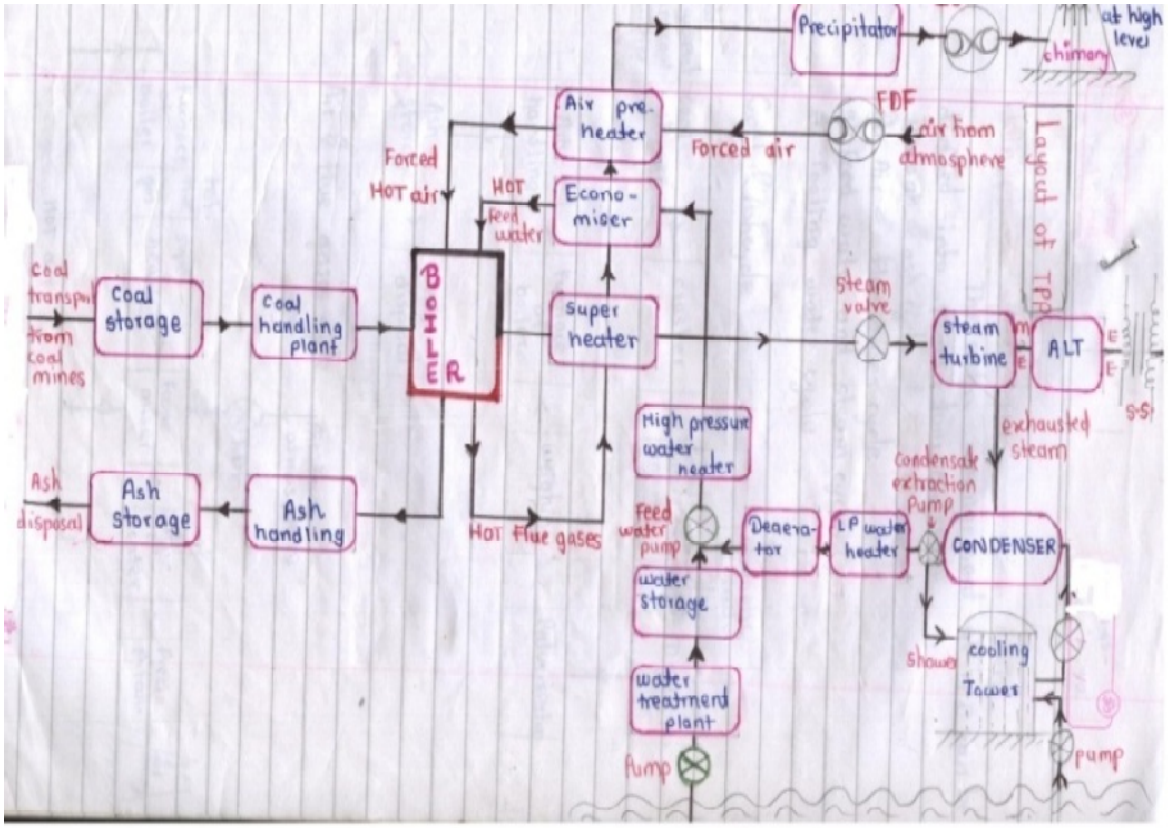
iii) Third stroke Expansion or power stroke-……..... **(1 Mark)**

- During this stroke both IV & EV remain closed.
- Due to combustion of fuel pressure in cylinder increases.
- So piston is pushed down with a large force.
- Expansion of gases takes place and work is done during this stroke.
- Expansion stroke is completed when piston reaches point BDC position.

iv) Fourth stroke Exhaust stroke- …….....(1 Mark)

- During this stroke IV remain closed while EV remains open.
- Piston moves up from BDC to TDC position.
- So it pushed out the burned gases (smoke) from engine.
- The stroke is completed when piston reaches the TDC position.
- And cycle is repeated.

d) Draw a neat labeled block diagram of thermal power station. ……(4 Mark)



OR equivalent figure

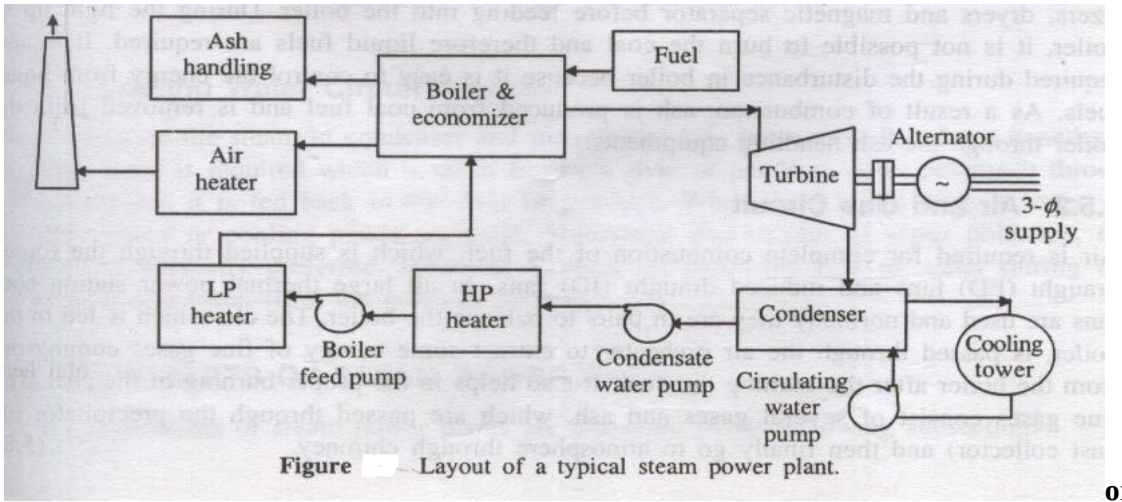
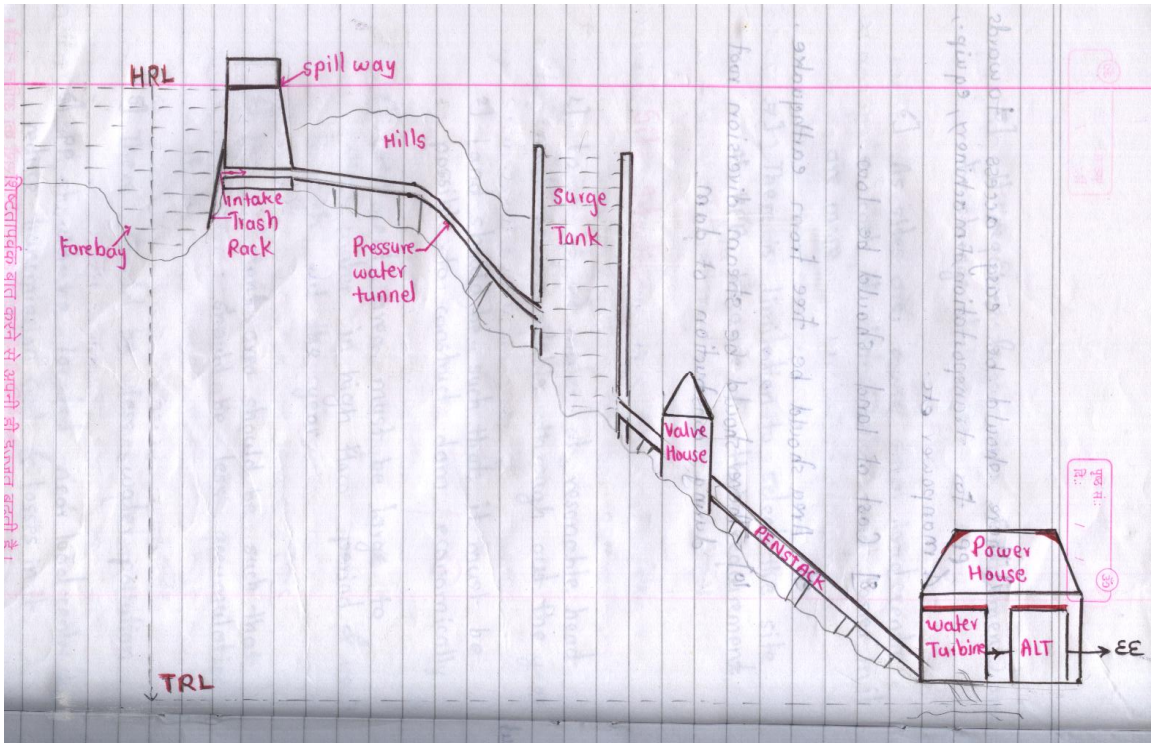


Figure Layout of a typical steam power plant.

or equivalent figure

e) Give the schematic arrangement of hydro-electric power plant. Also write the function of dam and surge tank.

Schematic Arrangement :…… (2 Mark)



Function of Dam:…… (1 Mark)

It develops reservoir which has a capacity to store water. It increases storing capacity of water reservoir. And it helps to increase the working head of water.

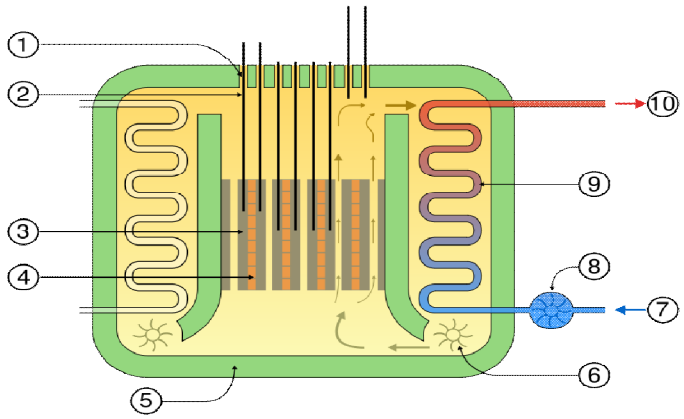
Function of Surge Tank:--…….. (1 Mark)

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

- It avoids cavity effect when load on turbine increases.
- It avoids water hammer effect when load on turbine reduces.

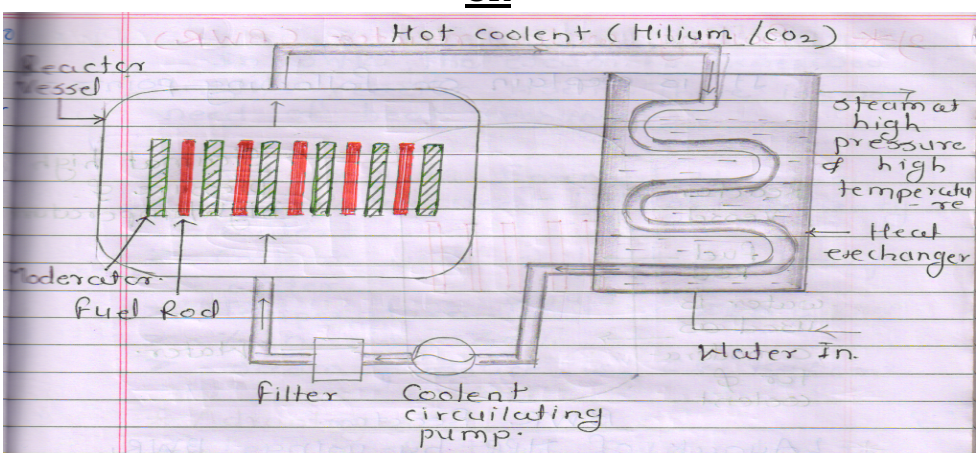
f) With a neat diagram, Explain the main features of advanced gas cooled reactor.

Diagram :…… (2 Mark)



1. Charge tubes 2. Control rods 3. Graphite moderator 4. Fuel assemblies
5. Concrete pressure vessel and radiation shielding 6. Gas circulator 7. Water
8. Water circulator 9. Heat exchanger 10. Steam

OR



The main features of advanced gas cooled reactor:…… (2 Mark)

- Fuel used is Uranium.
- Moderator used is Graphite.
- Coolant used is CO2/ Helium.
- Temperature obtain is 562^0C.
- Percentage efficiency is 40 %.
- Steam pressure is 162 Kg/cm^2

Q.4 Attempt any Four of the following: ----------16 Marks

a) What factors have to be kept in view while selecting site for hydro-electric plants.

(Eight Points are Expected) :…… (1/2 Mark to each)

Following Factors to be kept while site selecting for Hydro power plant.

1) **Quantity of water available :-**Where high rainfall occures so that sufficent quantity of water can be stored for generation of electricity through out year.
2) **Water Storage :-**Catchment area must be large to collect water in high flow period and used throughout the year. Water is stored by constructing dam across river.
3) **Head of Water :-**Stored water must have high head as high head reduces quantity of water required to run the turbine.
4) **Hilly Area :-** If site is located in hilly area then, it reduces construction cost of dam and for catchment area.
5) **Rocky(Hard Murrum) area -** To reduce the construction cost of damp and other structure it is necessary that area should be rocky.
6) **Free from Earthquake :-**The Area should be free from earthquake.
7) **Water pollution :-** It is necessary to see that water is of good quantity(no chemical impurities) because polluted water make cause corrosion.
8) **Silt/debris:-** The catchment area should be such that there are less accumulation of silt because capacity of storage reservoir will reduce due to the gradual deposition of silt, debris (means unwanted solid partials) and it should be minimum.
9) **Transportation Facility:-** The site selected for hydro power station accessible by rail & road so that necessary equipment & machinery could be easily transported.
10) **Cost of land:-**Cost of land should be less.
11) **Near to load centre:-**It should be located as far as possible near load center to reduce transmission line cost.

OR

The following are the points to be considered for the selection of site for hydroelectric power station.

1. Abundant quantity of water at reasonable head must be available.
2. It must be possible to construct an economical dam.
3. Transport facilities for workers and material must be made available, i.e., the site should easily be accessible.
4. Availability of labor at a cheaper rate.
5. It should allow strong foundation with low cost.
6. Sittings reduce the reservoir capacity. So, the rate of sitting should not be high.
7. Structures of cultural or historical importance should not be damaged.

8. There should be no possibility of future sources of leakages of water.
9. A large catchments area must be available.
10. During the construction period, it should be possible to divert the stream.
11. Sand, gravel, etc., should be available nearby.

b) Explain any six applications of diesel power plants.

Applications of Diesel Power Plant: (Any six points expected: for first two applications 1 mark each & remaining four applications 1/2 Mark each)

i) It can be used as a standby (emergency) power plant to maintain continuity of supply.

ii) It is suitable where power requirement is small.

iii) It is widely used in transportation system. E.g. Elect. Traction, Ship, Aero plane etc.

iv) It is suitable as a peak load power plant for short duration.

v) Mobile DEPP mounted on vehicle is used in emergency requirement and for temporary purpose.

vi) It is used in remote places where supply from grid is not possible.

vii) It is very economical to supply power to small scale industry which works for seasonal period.

viii) The use of such plant is very common during construction stage of HPP/TPP/NPP and other construction.

c) A power station has a maximum demand of 15000kW. The annual load factor is 50% and plant capacity factor is 40%. Determine the reserve capacity of the plant.

Given data- M.D.=15000 KW, L.F.= 0.5, C.F.=0.4
Find- the reserve capacity of the plant

Solution-

Capacity factor = load factor x utilization factor

$$\therefore \text{utilization factor} = \frac{\text{Capacity factor}}{\text{load factor}}$$ ..... **(1/2 marks)**

$$\therefore \text{utilization factor} = \frac{0.4}{0.5}$$

$\therefore$ utilization factor = 0.8 ..... **(1/2 marks)**

$$\text{Plant capacity} = \frac{\text{maximum demand}}{\text{utilization factor}}$$ ..... **(1/2 Marks)**

$$\therefore \text{Plant capacity} = \frac{15000}{0.8}$$

$\therefore$ Plant capacity $= 18750\,KW$ ..... **(1/2 Marks)**

Reserved capacity = Plant capacity - Maximum demand ..... **(1 Marks)**

= 18750 – 15000

= **3750 KW**.....Ans **(1 Marks)**

d) What is a cooling Tower? Where is it used? Explain its working details.

- **Cooling Tower:** .....**(1 Marks)**

The cooling tower is used to reduce the temperature of water coming from condensers & reused the same.

- **It is used-** .....**(1 Marks)**

In case of thermal, nuclear power station & for similar application.

- **Working-** .....**(2 Marks)**

The water coming from condenser is dropped in the cooling tower from a height of about 8–10 m. The cooling tower reduces the temperature of the hot water by about 7°C–10°C. This water at the reduced temperature is re-circulated to the condenser and the cycle is repeated.

In the cooling tower temperature of water is reduced either by natural or by forced or by induced draught method or by combine method.

e) Describe the following systems of a diesel electric plant: i) Engine starting system ii) Engine exhaust system.

i) Engine starting system:- .....**(2 Marks)**

This system is provided to rotate the engine initially until the firing starts and engine run under its own power.

Different ways of starting are as below-

- For small engine it is started manually by handle.
- By use of battery operated electric motor.
- For large diesel engine started by use of compressed air.

ii) Engine exhaust system:- ……..……(2 Marks)

This system is provided to discharge engine exhaust (smoke) to the atmosphere. It consist of

- Silencer- It provides to reduce noise.
- Muffler- It is provided over exhaust pipe to reduce pressure in the exhaust line & eliminate most of the noise

f) State the function of Natural, Mechanical, forced and induced draught systems.

(1 Marks each Function)

Function of Natural draught systems- Is to reduce temperature of water in cooling tower by the use of natural (atmosphere) air.

Function of Mechanical draught systems- Is to reduce temperature of water in cooling tower by the use of fan.

Function of Forced draught systems- Is to reduce temperature of water in cooling tower by the use of forced draught fan.

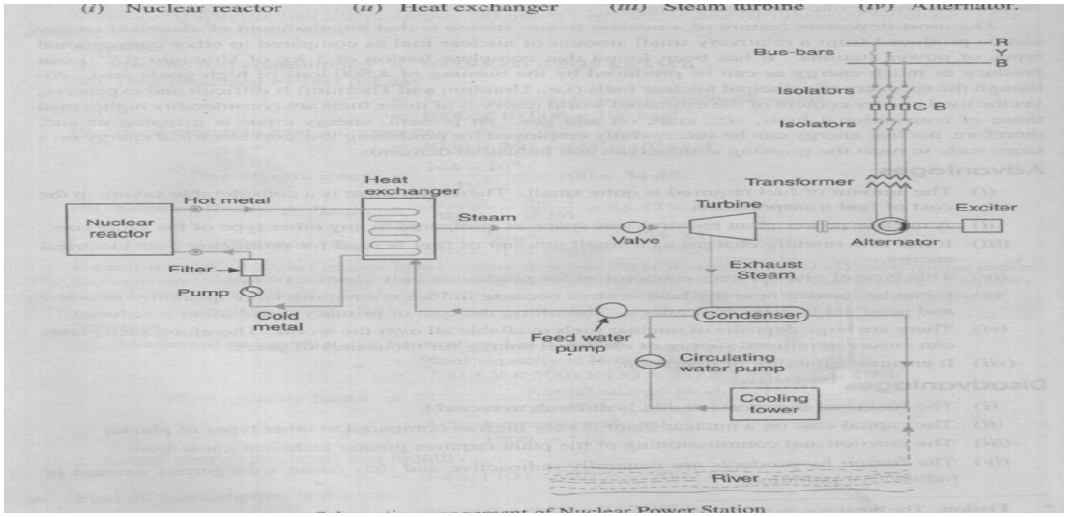
Function of Induced draught systems- Is to reduce temperature of water in cooling tower by the use of induced (exhaust) draught fan.

Q.5) Attempt any Four of the following: ----------16 Marks

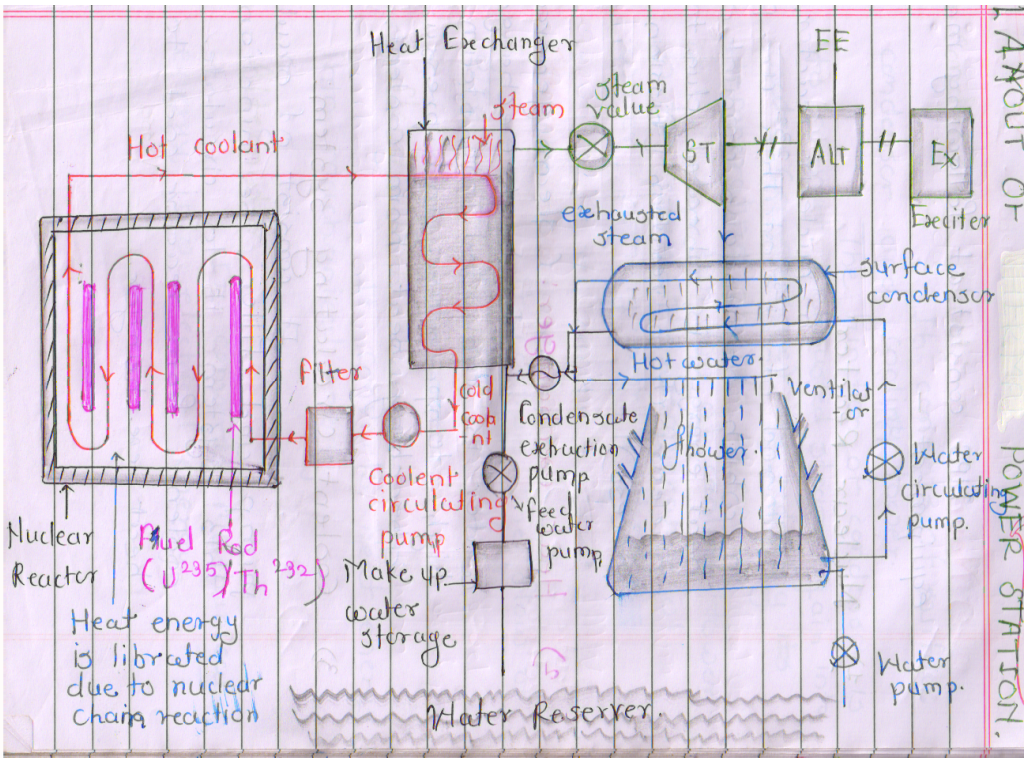
a) Draw the schematic arrangement of a typical Nuclear power plant and state the function of reflector.

Schematic arrangement ……..……..(3 Marks)

Sschematic arrangement of a typical Nuclear power plant:



OR equivalent Figure



Function of reflector :- …… **(1 Mark)**

The function of reflector is to reflact nutron which are escaping from chain reaction back into the reactor core.

b) What is Solar Collector? Give any three advantages of concentrating collector over flat type collector.

Solar Collector- …… (1 Mark)

Solar collector is a device which is used to collect & absorb the solar energy radiated from sun.

It is an essential device for converting the solar energy into the heat energy.

Advantages of concentrating collector over flat type collector-

(Any three advantages are expected- 1 Mark each advantages)

1. Heat losses are less
2. Efficiency is high
3. The collector area is more than the absorber area
4. High temperature is obtained
5. Suitable to generate steam
6. Heat insulation cost is less
7. Little or no anti-freez protection is required to protect the absorber.

c) What are the reasons for variation in solar radiation reaching the earth and that received at the outside of the atmosphere?

Following are the reasons for variation in solar radiation-

1. **Absorption- ……(2 Marks)**

As solar radiation passes through the atmosphere-

- The short wave ultra-violet rays are absorb by the ozone in the atmosphere
- And the long wave infra-red waves are absorbed by carbon di-oxide (CO_2) and moisture in the atmosphere.

2. **Scattering- ……(2 Marks)**

As solar radiation passes through the atmosphere-

- The component of the atmosphere such as water vapour and dust, scatter a portion of solar radiation.

d) How are nuclear reactors controlled? Explain two different methods in brief.

Nuclear reactors controlled by two methods-

1. **With the help of control rod- …… (2 Mark)**
   By adjusting height of control rods in reactor core according to requirement we can control the chain reaction.
   - When control rods are pushed deep in the core then it absorbs all neutrons from the fission process. Hence chain reaction will stop automatically.
   - However, when control rods are being withdrawn then more & more neutrons causes fission process & hence intensity of chain reaction(heat produced) will increased.
   - Therefore pulling out of control rods from the core, power of nuclear reaction will increase. Whereas by pushing control rod towards the core it will reduce.

2. **By adjusting value of multiplication factor (k)- ……...(2 Mark)**
   - At the time of starting chain reaction, value of multiplication factor (k) should be kept greater than one.
   - At the time of steady condition chain reaction, value of multiplication factor (k) should be kept equal to one.
   - At the time of shutting down chain reaction, value of multiplication factor (k) should be kept less than one.

   In this way nuclear reactor is controlled.

e) Explain the following terms as referred to a Hydro-electric Power plant:

i) Surface run-off ii) Precipitation iii) Evaporation iv) Water Hammer.

(1 Marks Each terms)

i) Surface run-off -

It is that portion of Precipitation which actually flows towards stream, lake, river or ocean.

OR

Surface run-off = Total Precipitation – Total Evaporation of water

ii) Precipitation -

Precipitation is nothing but rain fall. This includes all the water that falls from atmosphere (sky) to the earth surface.

iii) Evaporation –

It is the transfer of water from liquid to vapour state.

iv) Water hammer effect-

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'. OR**

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.

f) State the function of following components of a nuclear power station:

i) Moderator ii) Shielding iii) Control rod iv) Coolant (1 Mark Each Function)

i) Function of Moderator :-

Moderator is to moderate or reduce the speed of fast neutron to help the fission process.

ii) Function of sheilding :

Sheilding is to protect environment, humens and animals from the harmful radioactive radiation (pollution).before they are emitted to atmosphere from reactor.

OR

The function of shielding is to absorbs nuclear radiation (α, β, γ) before they are emitted from reactor to atmosphere

In this way it protect the oprater from harmful effect due to nuclear radiation and aslo aviod radioactive air pollution.

iii) Function of Control Rod:

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. **OR**

The function of control rod is to control the chain reaction in reactor core by adjusting its height

iv) Function of Coolant:

The function of coolant is to absorbs heat from reactor core and transfer it in heat exchanger for producing steam at high pressure and temperature.

Q.6) Attempt any Four of the following: ----------16 Marks

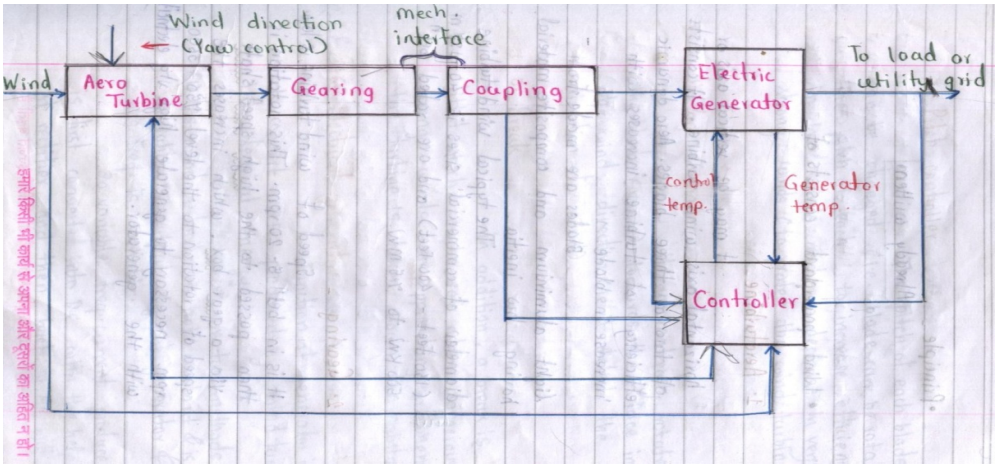
a) Give any four limitations of wind energy.

Following are the Limitations of wind energy (Any four points are expected: 1 Mark each)

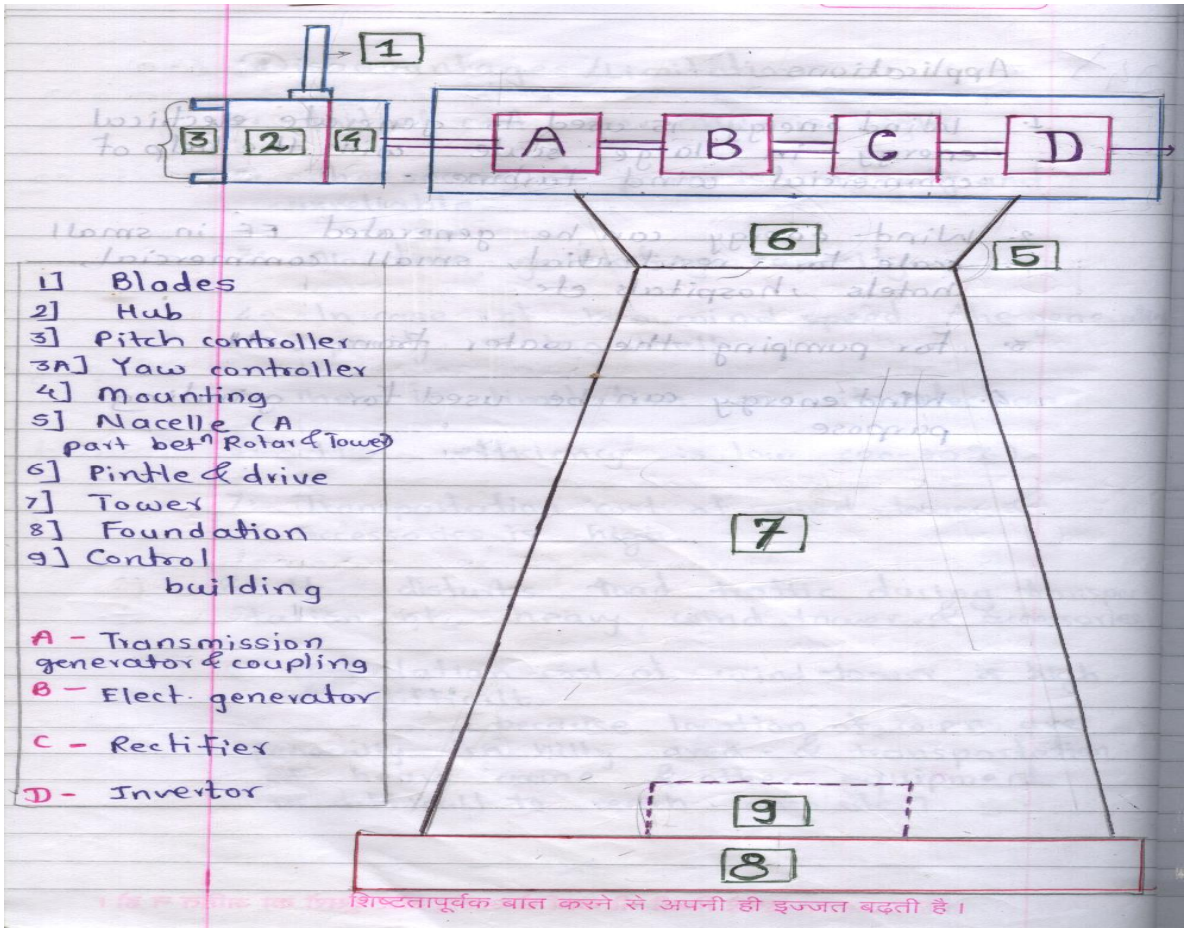
1. Initial cost per MW is high.
2. The source of power (wind) is unsteady and unreliable.
3. No firm generating capacity.
4. In case of low wind, power cannot be generated.
5. It's efficiency is low (20% -30%).
6. There is limitation on site selection.
7. Transportation cost of wind tower and accessories 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 hill area and transportation of heavy urban and other equipments is difficult to reach upto the side.
10. It produces noise.

b) Draw the block diagram for wind energy conversion system and mark all the components.

(Figure- 2 Mark & Marking-2 Mark)



OR Equivalent Figure



OR Equivalent Figure

c) What is interconnected system? Write any three advantages of this system?

Interconnected system: ……..…….. (1 Mark)

When the number of generating stations .eg. hydro, thermal, nuclear, gas P.P are interconnected through transmission line works in combination with each other to supply the power economically to the consumer, this system is known as interconnected power system.

Advantages of interconnected Systems:

(Any three points expected each point 1 Mark)

i) Reduced Overall installed Capacity:-

Inter connected power systems reduce the overall requirement of installed capacity. With interconnection between power systems, peak demand in an area is meet by importing power from neighboring area. Thus, it also reduces investment and fulfills the peak demand.

ii) Better Utilization Hydro Power:-

In combined power system, hydro power can be utilized in more effective way. during rainy season, hydro power plant can be utilized, while during draught periods, steam power plant can be used as base load plant.

iii) Reliability of Supply:-

The reliability of steam power plants depends upon the coal supply and that of hydro power plant depends upon the stream flow. due to greater diversity, a combined operation of various types of power plant is more reliable than individual power plant.

iv) High unit size possible:-

Generating units of higher unit capacity (200MW, 500MW etc) can be installed and operated economically.

v) Improved quality of voltage and frequency:-

Isolated power systems have higher frequency fluctuations with change in load. With inter connections, the system becomes stronger & the effect of load is reduced.

vi) Exchange of peak loads:-

If the load curve of power station shows a peak demand that is greater than the rated capacity of the plant, then the excess load can be shared by other stations connected with it.

vii) Use of older Plants:-

The interconnected system makes it possible to use older and less efficient plants to carry peak loads of short durations. Although such plants may be inadequate when used alone, yet they have sufficient capacity to carry short peaks up load when inter-connected with other modern plants.

viii) Insure Economical operation:-

The interconnected system makes the operation of concerned power station quite economical. It is because sharing of loads among the stations is arranged in such a way that more efficient plants work for peak load hours only.

ix) Increases Diversity factor:-

The maximum demand on the system is reduced because load curves of different inter-connected stations are different. So, diversity factor of the system is improved, thereby increasing the effective capacity of the system.

x) Increases load factor:-

The load factor and efficiency of operation are improved.

xi) Reduces Plant Reserve capacity:-

Every power station is required to have a standby unit for emergencies. However when several power stations are connected in parallel, the reserve capacity of the system is mush reduced. This increases efficiency of the system.

xii) Better utilization of natural resources:

Due to interconnection, there is optimum utilization of available natural resources in the country is possible.

d) What is radioactive Isotope? Give one example. Also explain mass defect and binding energy in brief.

Radioactive Isotope: …… (1 Mark)

A radioactive isotope is an isotope that naturally or artificially created within nature. During fission process they emit radioactive radiation alpha, beta, gama rays until stability is reached.

Example of Radioactive Isotope: …… (1 Mark)

$_{92}U^{234}$, $_{92}U^{235}$, $_{92}U^{238}$

Mass Defect: …… (1 Mark)

We know that an atom consists of protons, neutrons, and electrons; each one of which possesses a finite mass. However, the weight of an atom is always less than the sum of the weights of its protons, neutrons, and electrons. **The difference is known as the *mass defect*.**

Binding energy: ……..…… (1 Mark)

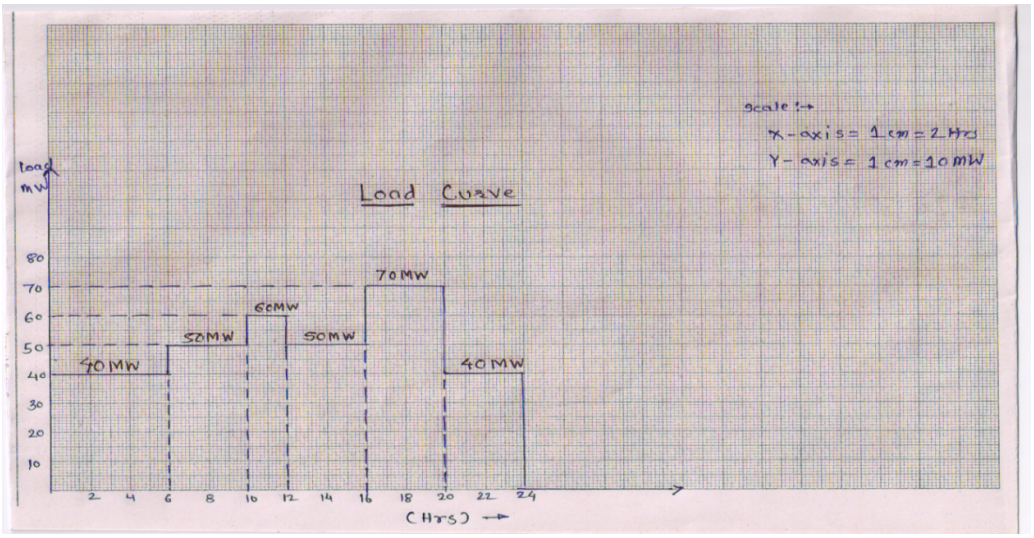
The energy required to split (to overcome) nucleus an atom into its component parts. The components part are protons and neutrons. It's unit is (M_eV) Mega electron volt.

e) A generating station has the following daily load cycle.

Times in Hrs.	0-6	6-10	10-12	12-16	16-20	20-24
Load in MW	40	50	60	50	70	40

Draw the load curve and find: i) Maximum demand ii) units generated per day iii) Average load iv) Load factor

Load Curve:- **(1 Mark)**



Note :- Student may select Scale may be different so consider

i) It is clear from the load curve that maximum demand on the power station is **70 MW**

Maximum Demand: 70 MW ---------- **(1/2 Mark)**

ii) Units generated /day =

$$= Area\,(in\ KWh)\ under\ the\ load\ \ curve$$

$$= 10^3\ (40\times 6+50\times 4+60\times 2+50\times 4+70\times 4+40\times 4)$$

$$= 10^3\ (240+200+120+200+280+160)\ \ kWh$$

$$= 1200\times 10^3\ \ KWh$$ ---------- **(1 Mark)**

iii) Average Load =

$$= \frac{Units\ \ generated\ \ per\ day}{24\ hours} = \frac{1200\times 10^3}{24} = 50000\ KW$$ --------- **(1 Mark)**

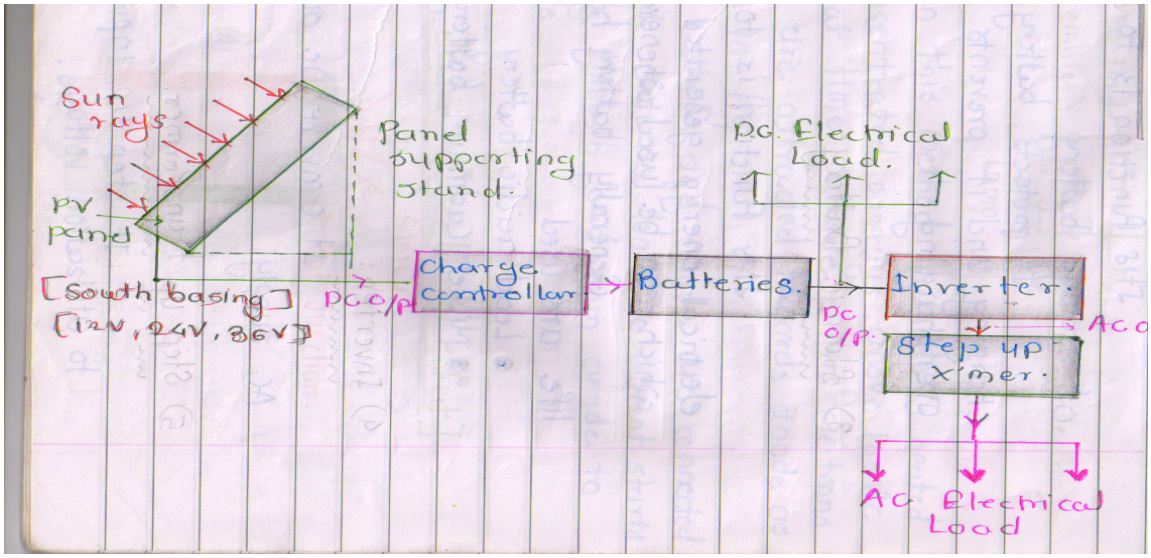
iv) Load Factor =

$$= \frac{Average\ \ load}{Maximum\ demand} = \frac{50000}{70\times 10^3} = 0.71428$$

$$= 71.42\ \%$$ ---------- **(1/2 Mark)**

f) Draw the basic photo voltaic system for power generation and state the function of each block …… (for block diagram 2 marks & function 2 marks)

Block diagram for basic photo voltaic system:-



OR Equivalent Figure

Function of each block:

1) **Photovoltaic cell panel**-

Its function is to convert energy of sunlight directly into DC electricity.

2) **Battery charge controller**-

Its function is to increase life of storage battery.

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

3) **Storage battery**-

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

Battery has long life.

Commonly used batteries are-

- Lead acid battery
- Nickel cadmium battery

4) **Inverter**-

It converts DC supply into AC supply

5) **Step-up transformer**-

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