



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

Summer – 2018 Examinations

Subject Code : 17324 (EPG)

Model Answer

Page No : 1 of 21

Important Instructions 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 importance (Not applicable for subject English and Communication Skills).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure/figures 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 (as long as the assumptions are not incorrect).
- 6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept



1 Attempt any ten of the following:

20

1 a) State the importance of electrical power.

Ans:

Importance of Electrical Power:

- 1) Electrical energy is the basic necessity for domestic, commercial, industrial, agricultural consumers, transport (electric trains), battery operated vehicles etc.
- 2) Electricity is also basic necessity for economic development of a country. In fact, advanced country is measured by the index per capital consumption of electricity. If it is more, the country is said to be developed and advanced.
- 3) Electricity is used for various purposes such as,
 - i) Lighting, heating, cooling and other domestic appliances
 - ii) Street lighting, flood lighting, office building lighting and powering to PCs etc.
 - iii) Irrigation purpose, operating cold storage, for various agriculture products.
- 4) Running motors, furnaces of various kinds in industry, running locomotives (electric train)

Any two
points
= 2 marks

1 b) List the renewable energy sources.

Ans:

Renewable Energy Sources:

- 1) Solar energy
- 2) Wind energy
- 3) Hydro energy
- 4) Ocean energy:
 - (i) Ocean tidal energy
 - (ii) Ocean wave energy
 - (iii) Ocean thermal energy
- 5) Bio energy:
 - (i) Bio-fuels
 - (ii) Bio-mass
 - (iii) Bio-gas
- 6) Geothermal energy
- 7) Fuel cells

½ mark for
each of any
four
= 2 marks

1 c) What is captive power plant?

Ans:

Captive Power Plant:

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.

2 marks for
correct
answer

1 d) List any two hydro power plants in Maharashtra with their generating capacity.

Ans:



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

Summer – 2018 Examinations

Subject Code : 17324 (EPG)

Model Answer

Page No : 3 of 21

Hydro Power Plants in Maharashtra:

Sr. No.	Name / Location	Capacity
1	Koyana	1960 MW
2	Mulshi Dam	150 MW
3	Jayakwadi	12 MW
4	Chandoli (Warana)	16 MW
5	Ujani	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	Pawana	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

½ mark for
name/locati
on & ½
mark for
capacity
= 1 mark for
each of any
two
= 2 marks

1 e) What is pulverized fuel? State any two advantages.

Ans:

Pulverized fuel:

Pulverized fuel (PF) is coal, or sometimes hard pitch obtained from the distillation of coal tars, which has been ground into small particles. The finely-ground fuel is burned at a nozzle or jet in a similar way to gas or liquid fuel.

1 mark for
definition

Advantages of Pulverized fuel:

- Cheaper and lower grade fuels can be burned as PF.
- The burners readily respond to load changes.
- Burning losses are practically eliminated.
- Automatic control can be used.
- Very high air pre-heat temperatures can be used.

1 mark
(any two
advantages)



vi) Steam output is higher than when burning solid fuel on grates.

1 f) What are the various sources of energy?

Ans:

Various sources of energy:

- i) The Sun
- ii) The Wind
- iii) Ocean tides and waves
- iv) Terrestrial Heat
- v) Water
- vi) Fuels
- vii) Radio- active Elements.

½ mark for
each of any
four sources
= 2 marks

1 g) State any two disadvantages of thermal power station

Ans:

Disadvantages of thermal power station:

- i) High maintenance and operating costs.
- ii) It pollutes the atmosphere due to the production of large amount of smoke and fumes.
- iii) Disposal of ash is quite difficult.
- iv) Requires huge quantity of water.
- v) Handling of coal is difficult.
- vi) Costlier in running cost as compared to hydroelectric plant.

1 mark for
each of any
two
= 2 marks

1 h) State the function of condenser.

Ans:

Function of Condenser:

After expansion through the prime mover, the steam passes through the condenser which condenses the exhaust steam and also removes air and other non-condensable gases. The recovery of exhaust steam in the condenser reduces the make-up feed water that must be added to the system.

2 marks for
correct
answer.

1 i) Define Firm power and connected load.

Ans:

(i) Firm power:

It is the power which should always be available even under emergency conditions.

(ii) Connected load:

The connected load of a consumer is the sum of continuous rating of all equipment of the consumer connected to supply system which is in use or not in use.

1 mark for
each
definition

1 j) Name any four applications of diesel power plants.

Ans:

Applications of Diesel Power Plants:

- i) Hospitals.
- ii) Telephone exchanges.
- iii) Radio stations and cinemas.
- iv) Used to supply peak loads for small duration or for seasonal loads.
- v) Used in remote places where supply from grid is not available.

½ mark for
each of any
four sources
= 2 marks



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

Summer – 2018 Examinations

Subject Code : 17324 (EPG)

Model Answer

Page No : 5 of 21

vi) Used in transportation systems such as railroads, ships, airplanes, automobiles.

1 k) State four nuclear power plants in India.

Ans:

Nuclear power plants in India:

Sr.No.	Name	Location	State	Capacity (MW)
1	Tarapur Atomic power station (APS)	Tarapur	Maharashtra	1400
2	Madras APS	Kalpakkam	Tamilnadu	440
3	Kaiga APS	Kaiga	Karnataka	660
4	Kakrapur APS	Surat	Gujrat	1840
6	Kundankulam APS	Kundankulam	Tamilnadu	4000
7	Narora APS	Narora	U.P.	440
8	Rajasthan APS	Pawatbhata	Rajasthan	1180

½ mark for each of any four power plant = 2 marks
(Location, state, capacity optional i.e no marks)

1 l) List any four electrical equipment used in hydroelectric power plant.

Ans:

Electrical equipment used in hydroelectric power plant:

- i) Generator
- ii) Power transformers
- iii) Circuit breakers
- iv) Bus
- v) Dis-connectors (Isolators)
- vi) Power cables

½ mark for each of any four equipment = 2 marks

1 m) List the main parts of diesel electric power plant.

Ans:

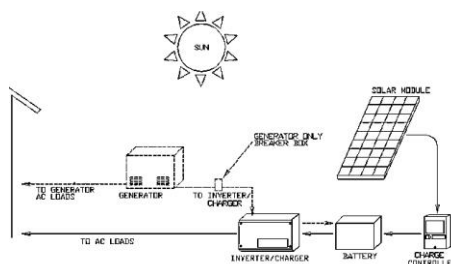
Main parts of Diesel Electric Power Plant:

- i) Diesel Engine
- ii) Air Intake (Air filters, ducts, Supercharger)
- iii) Engine fuel system (Fuel storage tanks, fuel storage pumps, Heaters)
- iv) Engine exhaust system (Silencers, connecting ducts)
- v) Engine cooling system (Cooling pumps, cooling towers or spray ponds)
- vi) Engine lubricating oil system (Lubricating oil pumps, Oil tank filters, coolers, Purifiers)
- vii) Engine starting (Battery, Starter, Compressed air supply)
- viii) Diesel Engine Generator (Alternator).

½ mark for each of any four parts = 2 marks

1 n) Draw the diagram of solar energy.

Ans:



2 marks for neat labeled diagram.

1 mark for partially labeled diagram.

Or equivalent diagram.



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

Summer – 2018 Examinations

Subject Code : 17324 (EPG)

Model Answer

Page No : 6 of 21

2 Attempt any four of the following:

16

2 a) Define (a) Thermal efficiency (b) Calorific value

Ans:

(a) Thermal efficiency:

Thermal efficiency is defined as the ratio of heat equivalent of mechanical energy transmitted to the turbine shaft to the heat of combustion of coal.

2 marks



(b) Calorific value:

The amount of heat released by a unit weight or unit volume of a substance during complete combustion.

2 marks

OR

The quantity of heat produced by the complete combustion of a given mass of a fuel, usually expressed in joules per kilogram.

2 b) State any eight advantages of nuclear power station.

Ans:

Advantages of Nuclear Power Station:

- 1) Fuel requirement for generating a given amount of electrical energy is very small as compared to others.
- 2) It is efficient when operated at rated capacity.
- 3) They reduce the demand for coal, gas and oil.
- 4) Fuel requirement is only in kilograms. Hence, there is no problem for transportation, storage etc.
- 5) It requires less area as compared to any other plant of the same capacity.
- 6) The running costs are less.
- 7) For large capacity, nuclear power plants are more economical.
- 8) The cost per unit decreases when power generated is in large amount.
- 9) Output control is extremely flexible these are not affected by adverse weather conditions.
- 10) There are large deposits of nuclear fuels available all over the world, therefore such plants can ensure continued supply of electrical energy for thousands of year.
- 11) It ensures reliability of operations.
- 12) Operation is clean, no ash fumes etc.

½ mark for
each of any
eight
advantages
= 2 marks

2 c) Explain the basic components of a wind energy conversion system.

Ans:

Basic components of a wind energy conversion system:

1) Rotor /Blade/Aero-turbine:

Blade extracts significant power from the wind. They convert the force (K.E.) of the wind into the rotary motion to generate useful mechanical power.

2) Hub:

Hub of the wind turbine is that component which connects the blades to the main



shaft and ultimately to the rest of drive train. Hubs are generally made up of steel.

3) Main Shaft (Low speed shaft):

It is provided for transfer of torque from the rotor blade to the rest of the drive train. It also supports weight of rotor. Speed of the shaft is low, is about 30 to 60 rotations per minute.

4) High speed shaft:

It is connected to generator via-gearbox. Speed of the wind turbine is low; gearing arrangement increases the speed of rotation to the level as per design. e.g. 1500 rpm for 50 Hz frequency and 1800 rpm for 60 Hz frequency necessary to generate electricity with the help of generator. Gear box is one of the heaviest and most expensive components in wind turbine.

5) Coupling:

Coupling are used to connect shaft together



Between main shaft and gear box



Between gear box output and the generator.

½ mark for
any 8
components
with
function
= 4 marks

6) Brakes:

The brake is fitted to stop the wind turbine. By applying brake when dangerously strong wind are approaching i.e. when wind speed exceeds 55-65 miles per hour, the wind turbine is stopped to avoid damage. In case of emergency also it is used to stop the rotation of turbine. To take down the turbine for maintenance, brakes are applied to stop it.

7) Yaw Controller:

It brings the blades towards the face into the wind direction i.e. it detects the direction of wind. It performs the task of orienting the rotor in the direction of wind.

8) Pitch Controller:

The pitch controller adjust automatically the pitch of each blade i.e. blade can be rotate to increases efficiency in low wind and to decrease in very strong winds (to protect the wind turbine).

9) Electrical Generator:

Function of generator is to convert mechanical energy produced by wind turbine into electrical energy.

10) Anemometer:

It is a wind speed sensor with digital display, used in areas where AC power is not available. It monitors wind speed and store max and average value.

11) Controller:

Controller takes data from anemometer (which measures the wind velocity).

The controller sends: Wind direction & wind speed

The controller protect wind turbine from abnormal wind conditions, excessive temperature rise of generator, electrical fault etc.

12) Nacelle:

Nacelle cover provides weather protection for the principle components of the wind turbine. It is structure that houses all of the generating components like-gearbox, rotor shaft and brake assembly etc.

13) Tower:

A tower is needed to elevate the blades to where the wind is stronger and smoother



Towers support to raise the main part of the turbine up in the air.

- 2 d) Why it is necessary to interconnect generating systems? State any four advantages.

Ans:

Necessity of interconnected generating systems:

- i) There is continuously varying demand, so exchange of peak load is possible. 2 marks for necessity
- ii) It can improve stability in each system by balancing generation and load in the shortfall period.
- iii) It has environment friendly nature as the bulk amount of heat can be minimized.

Advantages of interconnected Systems:

- i) **Reduced Overall installed capacity:** Interconnected power systems reduce the overall requirement of installed capacity for a given load area. With interconnection between power systems, peak demand in an area is met by importing power from neighboring area. Thus, it also reduces investment and fulfills the peak demand. 2 marks for any four advantages.
- 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 plants 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 peak loads when inter-connected with other modern plants.
- viii) **Ensure 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 the plants having higher cost of generation 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



Summer – 2018 Examinations

Subject Code : 17324 (EPG)

Model Answer

Page No : 9 of 21

standby unit for emergencies. However when several power stations are connected in parallel, the reserve capacity of the system is much 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.

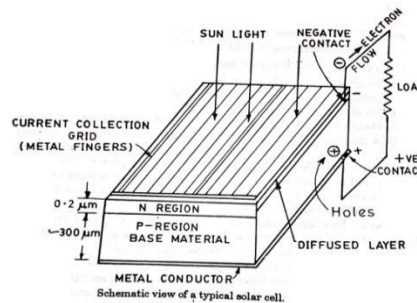
2 e) Explain the construction and principle of operation of photo voltaic cell.

Ans:

Construction of Photovoltaic Cell:

Energy conversion devices used to convert sunlight into electricity by the use of photovoltaic effect, are called “solar cells” or “photo-voltaic (PV) cells”. These are made up of a P-type and N-type semiconductors. The sun lights are absorbed by current collection grid which is made up of metal fingers. Figure shows schematic view of a typical solar cell.

2 marks for construction with diagram.



Principle:

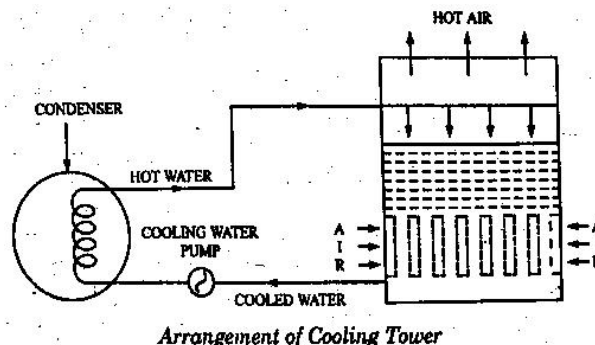
Photovoltaic effect is defined as the generation of the emf as a result of the absorption of ionizing radiation. When photons from the sun are absorbed in a semiconductor, they create free electrons with higher energies than the electrons which provide the bonding in the base crystal. There must be an electric field available to force these electrons to flow out of the semiconductor to do useful work. This electric field is provided in most solar cells by a junction of materials which have different electrical properties. Thus continuous radiation from sun generates electricity in semiconductor junction

2 marks for principle.

2 f) Draw and explain the function of cooling tower in a thermal power station.

Ans:

Cooling Tower:



2 marks for diagram.

Function of cooling tower:

Cooling tower is used to reduce the temperature of water coming from



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

Summer – 2018 Examinations

Subject Code : 17324 (EPG)

Model Answer

Page No : 10 of 21

condenser. A cooling tower is a steel or concrete hyperbolic structure. There is reservoir at the bottom for storing the cold water.

2 marks for
function

Water is circulated from the basin of the cooling tower to the condenser. It absorbs latent heat from the steam and get warm. This warm water is returned 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.

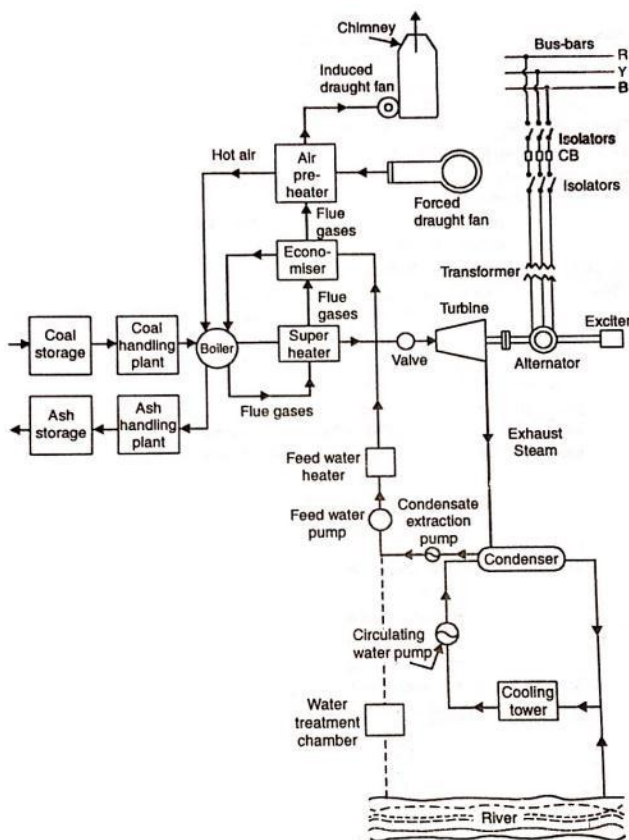
This water at the reduced temperature is recirculate through the condenser and the cycle is repeated. In cooling tower temperature of water is reduced either by natural or forced or induced draught method or combine.

3 Attempt any Four of the following:

16

3 a) Draw schematic diagram of thermal power station showing all its parts.

Ans:



4 marks for
labeled
diagram

3 marks for
partially
labeled
diagram

2 marks for
unlabeled
diagram

Schematic arrangement of Thermal Power Station

OR

Any Other equivalent diagram



MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

(Autonomous)

(ISO/IEC-27001-2005 Certified)

Summer – 2018 Examinations

Subject Code : 17324 (EPG)

Model Answer

Page No : 11 of 21

- 3 b) Write function, location and advantages of the following equipment used in hydroelectric power plant.
- Penstock
 - Spillways
 - Forebay
 - Tailrace.

Ans:-

i) Penstock:

Function:- Its function is to carry water from the water intake (reservoir) to turbine.

Location:- Penstock may be buried inside ground or it can be installed on the surface between reservoir and surge tank.

Advantage:- Releases the flood water and maintain the water level for electricity generation.

1 mark each
point
= 4 marks

ii) Spillways:

Function:- It has function of discharging all the water not utilised for generation. OR Acts as a safety valve for a dam. It discharges excess water when head of water increases above predetermine maximum level, at the time of heavy rainfall & during floods etc. In this way spill way avoids damage of dam due to excess pressure of water

Location:- Located at the top of dam , either within the body of dam, or at the end of it, or entirely away from it.

Advantage:- It avoids damage from excess water during flood of dam and concerned equipment.

iii) Forebay:-

Function:- The function of forebay is to act as regulating reservoir temporarily storing water when the load on the plant is reduced and to provide water for initial increment of an increasing load while water in the canal is being accelerated.

Location: - Either behind the dam or a canal spread out to accumulate the required width of intake.

Advantage:- It is intended to provide the temporary storage of water to meet hour-to-hour load fluctuations on the station.

iv) Tailrace:-

Function:- The water after running the turbine is to be discharged into the river/ocean/next stage of generation. For this purpose, a tailrace is required.

Location:- at starting of river, ocean or reservoir.

Advantage:- It provide channel to discharge water.

- 3 c) State types of solar cells.

Ans:-

Types of solar Solar cells:

- P-N Homo-junction.
- P-N Hetro Junction
- Hetro Junction –Homo Junction
- MIS (Metal Insulator semiconductor)
- SIS (Semiconductor insulator semiconductor)

4 marks any
four types

OR

**MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION****(Autonomous)****(ISO/IEC-27001-2005 Certified)****Summer – 2018 Examinations****Subject Code : 17324 (EPG)****Model Answer****Page No : 12 of 21**

1. Amorphous Silicon solar cell (a-Si)
2. Biohybrid solar cell
3. Cadmium telluride solar cell (CdTe)
4. Concentrated PV cell (CVP and HCVP)
5. Copper indium gallium selenide solar cells (CI(G)S)
6. Crystalline silicon solar cell (c-Si)
7. Dye-sensitized solar cell (DSSC)
8. Gallium arsenide germanium solar cell (GaAs)
9. Hybrid solar cell
10. Luminescent solar concentrator cell (LSC)
11. Micromorph (tandem-cell using a-Si/ μ c-Si)
12. Monocrystalline solar cell (mono-Si)
13. Multi-junction solar cell (MJ)

- 3 d) Compare thermal, hydro, nuclear and diesel power plants on the basis of (i) initial and (ii) running cost (iii) pollution effects (iv) applications.

Ans:-

Sr. No	Parameter	Thermal Power Plant	Hydro power plant	Nuclear Power Plant	Diesel Power Plant
1	Initial cost	Lower than hydro and nuclear	High due to large dam construction	Highest as cost of reactor construction is very high.	Less compared to other stations
2	Running cost	Higher than nuclear and hydro due to amount of coal required and heavy losses.	Practically very low as no fuel is required.	Low as very less amount of fuel is required but more than hydro stations.	Highest running cost due to high price of diesel.
3	Pollution effects	Harmful pollution effects	Most environment friendly	Hazardous for environment if nuclear waste are not properly disposed.	Harmful pollution effects
4	Applications	Economical to run as base load plant	It can be used for Base as well as peak load plant	Generally used as base load plant	Most suitable as peak load plant

4 marks

- 3 e) State any four advantages and disadvantages of wind power.

Ans:-**Advantages of wind energy system:**

1. Wind energy is freely available.
2. Wind energy is inexhaustible.
3. There is no air pollution.
4. No fuel transportation cost.
5. No space is required to store fuel.
6. No need on treatment on fuel.



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

Summer – 2018 Examinations

Subject Code : 17324 (EPG)

Model Answer

Page No : 13 of 21

7. No waste disposal cost and problem.
8. Less manpower is required per MW.
9. Layout is simple.
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 decreasing day by day.
15. Maintenance cost is less.

2 marks for
any 4
advantages

Disadvantages of wind power:

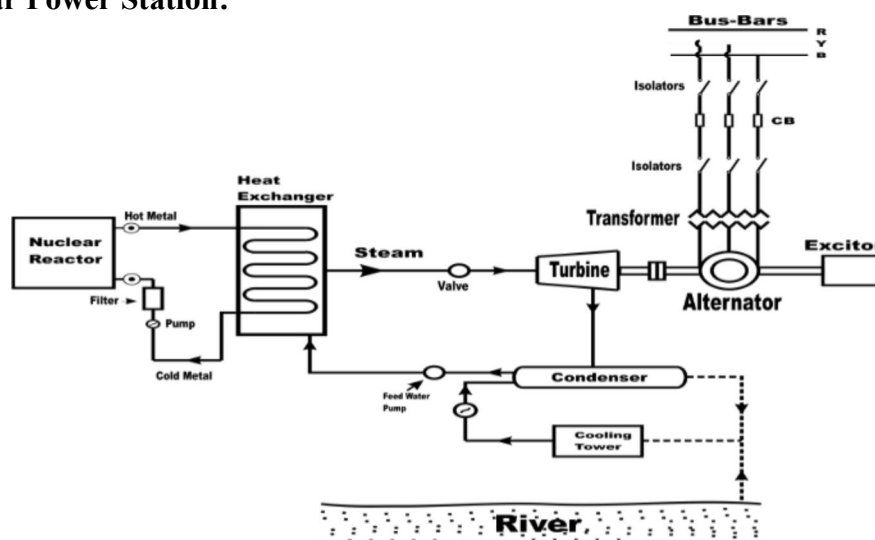
1. Initial cost per MW is high.
2. The source of power (wind) is unsteady and unreliable.
3. No firm generating capacity.
4. In case of low wind, power cannot be generated.
5. It's efficiency is low (20% -30%).
6. There is limitation on site selection.
7. Transportation cost of wind tower and accessories 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 equipment's is difficult to reach up to the side).
10. It produces noise.
11. The power quality of generated electricity is not superior.
12. Specific location is required.

2 marks for
any 4 dis-
advantages

- 3 f) Draw schematic arrangement of nuclear power stations and explain main stages.

Ans:-

Nuclear Power Station:



2 marks for
diagram

OR equivalent diagram

Main stages of Nuclear Power plant



- 1) Nuclear Reactor
- 2) Heat Exchanger
- 3) Steam Turbine
- 4) Alternator

1) Nuclear Reactor :

Nuclear Reactor is an apparatus in which fission of radioactive elements is carried out. It is a cylindrical pressure vessel in which fuel rods, moderator and control rods are placed. Fuel is shaped and located in the reactor in such a manner that the heat production within reactor is uniform. Moderator maintains the fission chain reaction. Control rods control the chain reaction.

2 marks for stages

2) Heat Exchanger:

The coolant carries the heat liberated in nuclear reactor to heat exchanger. In the heat exchanger, heat is utilized to convert water into steam. Coolant is re-circulated in nuclear reactor and then to heat exchanger.

3) Steam turbine:

The steam generated at a high temperature and high pressure in heat exchanger is passed through the steam turbine. The energy of steam is converted into mechanical energy by steam turbine. Steam turbine provides mechanical energy to alternator.

4) Alternator :

Alternator is a machine which converts mechanical energy into electrical energy, which is supplied to grid.

4 **Attempt any four of the following**

16

- 4 a) State any four different points which are taken into consideration for the site selection of nuclear power station.

Ans:-

Selection of site for Nuclear Power Plant:

1. It should be located near a river/Lake or seaside.
2. It should be located away from the populated area.
3. It should be located near load centre.
4. There should be easy access towards power plant.
5. It should be adequate space & arrangement for short time storage and long term disposal of the radioactive waste.
6. Land should be of good bearing capacity.
7. Area should be free from earthquake.
8. Land should be economical.

4 marks for any 4 points

- 4 b) What is necessity of economizer and super heater in thermal power plant?

Ans:-

Necessity of economizer: - It extracts the heat from flue gases and utilizes this heat to raise the temperature of feed water to the boiler, so that efficiency of overall system is increased.

2 marks
Each

Necessity super heater: - The steam produced in the boiler is not dry but contains some moisture. Such wet steam can damage/corrode and reduce the efficiency of the plant. Hence before supplying wet steam to turbine, it is passed through super-heater, where it is dried and superheated by the flue gases. Super-heater increases the overall efficiency of the plant.



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

Summer – 2018 Examinations

Subject Code : 17324 (EPG)

Model Answer

Page No : 15 of 21

- 4 c) A generating station has a connected load 120MW and it supplies a maximum demand 60 MW. The numbers of units generated in a year are 54794.5 Calculate:

- a) The Load factor.
b) The demand factor of generating station.

Ans:

Given data:

Connected load = 120MW = 120000 kW

Maximum demand = 60 MW = 60000 kW

Energy generated = 54794.5

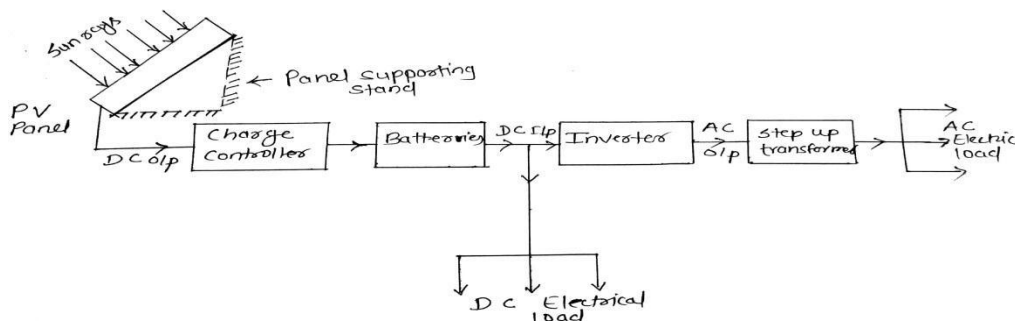
a) Load factor =
$$\frac{\text{Energy generated}}{\text{Connected load} \times 24 \times 365} = \frac{54794.5}{120000 \times 24 \times 365} = 0.9132 \text{ OR } 91.32\%$$

2 marks

b) Demand factor =
$$\frac{\text{Maximum demand}}{\text{Connected load}} = \frac{60000}{120000} = 0.5 \text{ OR } 50\%$$

2 marks

- 4 d) Explain how power is generated using solar energy?
Ans:-



2 marks for diagram

Working of solar power plant:

Solar power plant consists of following components:

1. Photovoltaic Cell panel:

Its function is to convert sunrays directly into DC electricity.

2. Charge Controller:

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

3. Storage Battery:

Its function is store DC electrical energy generated by P.V. cell.

4. Inverter:

It converts DC supply into AC supply.

5. Step-up transformer:

It step-up input voltage up-to utilization voltage.

2 marks for Explanation

OR equivalent answer

- 4 e) Distinguish between run off river plants without poundage and with poundage. (any four points)



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

Summer – 2018 Examinations

Subject Code : 17324 (EPG)

Model Answer

Page No : 16 of 21

Ans:-

Distinction between run off river plants without poundage and with poundage:

Sr. No.	Parameter	Run off River Plants	
		Without poundage	With poundage
1	Water storage	No	Yes
2	Usage	Only when water is available.	Used with available water or with stored water
3	Generating capacity	Depends primarily on rate of flow of water	Less dependent on available rate of flow of water
4	Seasonal changes	In rainy season water wastage occurs while in the low run off period water falls short to meet demand	Due facility of water storage its easier to meet fluctuating demand
5	Reliability	Less	More
6	Cost	Economical	Expensive

4 marks for
4 points

- 4 f) Compare jet condenser with surface condenser for initial cost, maintenance cost, space required for condensation.

Ans:-

Comparison of Jet Condenser with Surface Condenser:

Sr.No.	Points	Jet condenser	Surface condenser
1	Initial cost	Low manufacturing cost.	High manufacturing cost
2	Maintenance cost	Low maintenance cost	High maintenance cost
3	Space Required	Small floor space	Requires large floor space

4 marks

- 5 Attempt any four of the following.**

16

- 5 a) State methods of nuclear waste disposal.

Ans:

Methods of Nuclear Waste Disposal:

Solid radioactive wastes arise from used filters, sludge from the cooling ponds, discarded fuel element cans, splitters etc.

Solid waste can be disposed off by storing them in shielded storage vaults. These vaults or capsules can then be stored in deep salt mines or in deep wells drilled in the stable ocean floor.

Sometimes suitable containers are filled with radioactive waste and sunk to the bottom of seas and oceans.

Radioactive liquid wastes are discharged to sea by sufficient dilution of it.

Clinkering and solidifying liquid waste is another effective method of disposal.

Gaseous affluent are filtered before discharging to atmosphere.

2 marks for
solid waste
disposal,
1 mark for
liquid waste
&
1 mark for
gaseous
waste
disposal



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

Summer – 2018 Examinations

Subject Code : 17324 (EPG)

Model Answer

Page No : 17 of 21

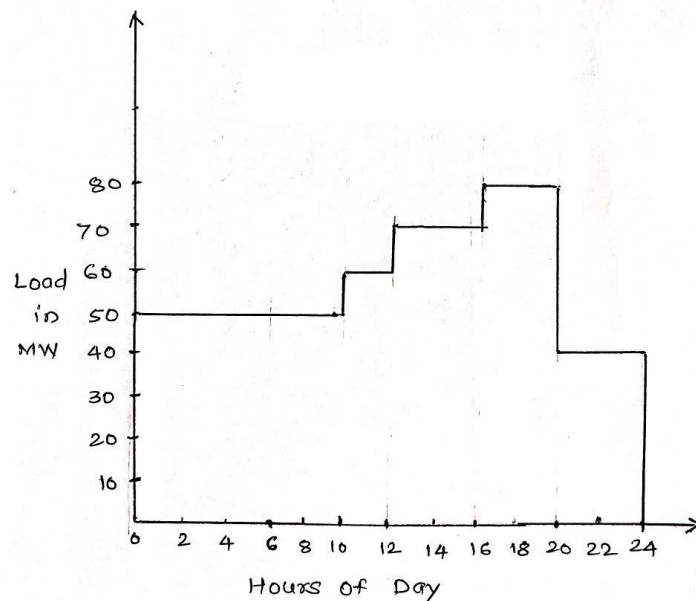
- 5 b) A generating station has following load cycle.

Time (Hours)	0-6	6-10	10-12	12-16	16-20	20-24
Load (MW)	50	50	60	70	80	40

Draw the load curve and find (i) Load factor (ii) kWh (iii) Average demand (iv) Maximum demand.

Ans:

Load Curve:



2 marks for
load curve

$$\begin{aligned}\text{Total units generated in 24 hours} &= (10 \times 50) + (2 \times 60) + (4 \times 70) + (4 \times 80) + (4 \times 40) \\ &= 500 + 120 + 280 + 320 + 160 \\ &= \mathbf{1380 \text{ kWh}}\end{aligned}$$

½ mark

Load factor = Average load/ Maximum demand

Max. demand = **80 kW** (from load curve)

Average load = $1380/24 = \mathbf{57.5 \text{ kW}}$

Load factor = L.F. = $57.5/80 = \mathbf{0.72}$

½ mark

½ mark

½ mark

- 5 c) With reference to diesel power plant, explain (i) Air intake system ii) Engine fuel system.

Ans:

i) Air intake system: Air intake system includes air filters, ducts and supercharger. Air intake system is provided to supply necessary air to engine for fuel combustion. Air filters are provided to remove dust and other suspended impurities from air to be supplied to the engine. Supercharger is usually employed to increase the pressure of intake air above atmospheric pressure to develop an increased power output. The air is drawn from outside the engine room and delivered to the inlet manifold through ducts and filters. The filters should be cleaned periodically. There should be minimum pressure loss in the air intake system.

2 marks

ii) Engine fuel system: It includes fuel storage tank, fuel transfer pumps, strainers,



MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

(Autonomous)

(ISO/IEC-27001-2005 Certified)

Summer – 2018 Examinations

Subject Code : 17324 (EPG)

Model Answer

Page No : 18 of 21

heaters and connecting pipes. The fuel oil is stored in bulk storage tanks which are usually situated outdoor for safety. The fuel oil is transferred to the small storage tanks called day tank by means of transfer pumps through filters. Strainers are provided to remove suspended impurities and ensure clean fuel supply to the engine. Heaters are required to heat the oil for energy conversion.

2 marks

- 5 d) Compare conventional and non- conventional sources of electrical energy with respect to (i) initial and running cost (ii) site (ii) sources of power (iv) overall efficiency.

Ans:

Comparison between Conventional and Non-conventional Sources:

	Conventional Sources	Non- conventional Sources
Initial and running cost	High initial and high running cost	High initial and Low running cost
Site	Particular site is required.	Particular site is required for some non-conventional sources.
Sources of power	Coal, Water, Nuclear material, Gas, Diesel - Limited in nature	Sunlight, air, geothermal, tidal, wind etc. - Unlimited in nature
Overall efficiency	Currently More	Currently Low

1 mark for each point
= 4 marks

- 5 e) In a nuclear power station state the material used for fuel rods, control rods, moderator and shielding.

Ans:

Sr. No.	Item	Material
1	Fuel rod	Uranium clad with aluminum/stainless steel or zirconium
2	Control rod	Control rods are composed of chemical elements such as boron, silver, indium and cadmium
3	Moderator	Hydrogen, Deuterium, Helium, Lithium, Beryllium, Graphite, Ordinary water, Heavy water
4	Shielding	Iron, Lead iron, dense concrete, Depleted uranium

1 mark for one material of each item
= 4 marks

- 5 f) Explain impulse turbines.

Ans:

Impulse Turbine:

When the entire pressure of water is converted into kinetic energy in a nozzle and the jet drives the wheel, the turbine is called impulse turbine. Pelton wheel is an impulse turbine. In this turbine water flowing over the turbine rotor blades remains constant. Impulse turbine is suitable for high head and low flow plants. The potential energy of water is converted into kinetic energy in a water jet issuing from a nozzle. The inside pressure is atmospheric. The rotor of turbine consists of elliptical shaped buckets along the periphery of the turbine. The water jet impinges on the buckets and causes the motion of the rotor. The water is then discharged to the tailrace. The quantity of water discharged by the nozzle is controlled by controlling the nozzle opening by means of needle. The movement of needle is



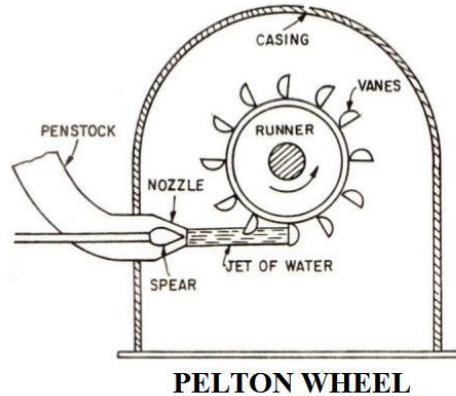
Summer – 2018 Examinations

Subject Code : 17324 (EPG)

Model Answer

Page No : 19 of 21

controlled by the governor.



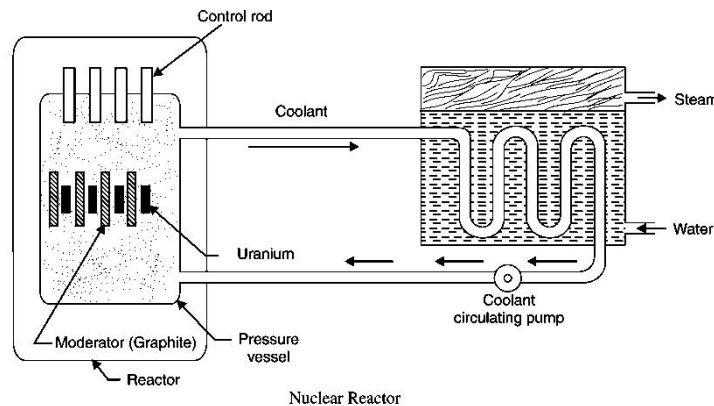
6 Attempt any four of the following

16

6 a) Explain nuclear reactor with diagram.

Ans:

Nuclear Reactor:



2 marks for
diagram

Nuclear reactor is that part of nuclear power plant where nuclear fuel is subjected to nuclear fission and the energy released in the process is utilized to heat the coolant which may in turn generate steam or be used in a gas turbine. The main function of the reactor is to control the emission and absorption of neutrons.

Basic components of nuclear reactor are:

- 1) **Reactor core:** It contains a number of fuel rods made of fissile material.
- 2) **Moderator:** It reduces the speed of neutrons to a value that increases the probability of fission process. Graphite, ordinary water, heavy water, hydrogen, deuterium etc. are used as moderators in reactors.
- 3) **Control rods:** They control the rate of fission of fuel.
- 4) **Coolant:** It is a medium through which the heat generated in the reactor is transferred to the heat exchanger for further utilization in power generation.
- 5) **Reflectors:** It is placed around the core to avoid leakage of neutrons from the core.
- 6) **Shielding:** It is used to protect the surrounding from radiations.

2 marks for
explanation

6 b) Explain the concept of water hammering in penstock in hydroelectric power station and how it can be reduced?



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

Summer – 2018 Examinations

Subject Code : 17324 (EPG)

Model Answer

Page No : 20 of 21

Ans:

Concept of Water Hammering:

In case of hydro generators when load on generator reduces, the governor closes the turbine gates and thus creates an increased pressure of water in the penstock. This is called water hammer. It may damage the walls of penstock.

4 marks

To avoid this harmful effect of water hammer, a small storage reservoir is provided which will receive this rejected flow. This storage tank is called the surge tank. This controls the reverse water velocity in penstock.

- 6 c) State any four merits and demerits of diesel power station.

Ans:

Diesel Power Station:

Merits:

- 1) The construction is very simple.
- 2) These plants can be located at any place (Load centre).
- 3) These plants can be quickly procured, installed and commissioned.
- 4) The layout, design and construction for foundation and building for these plants are simple and economical.
- 5) These plants can be started and put on load quickly.
- 6) No need of large amount of water for cooling.
- 7) Thermal efficiency is higher than steam power plant.
- 8) These plants require less space for fuel storage and are free from ash handling problems.
- 9) No standby losses.

½ mark for
each of any
for merits

= 2 marks

Demerits:

- 1) Operating cost is high.
- 2) Maintenance and lubrication cost is high.
- 3) These plants cannot supply overloads continuously.
- 4) Capacity is limited.
- 5) Noise from exhaust is a serious problem.
- 6) Useful life is very short.
- 7) Creates pollution.
- 8) Requirement of fuel is met from other countries.

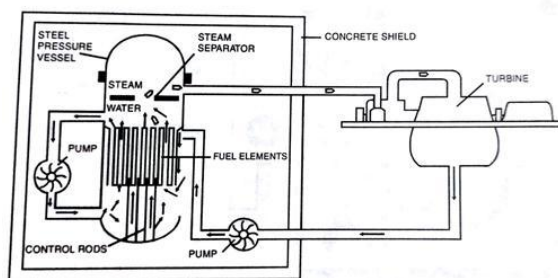
½ mark for
each of any
for demerits

= 2 marks

- 6 d) What is boiling water reactor? Explain with diagram.

Ans:

Boiling Water Reactor:



Boiling Water Reactor (BWR)

2 marks for
diagram

It has a steel pressure vessel surrounded by a concrete shield. Fuel used is enriched uranium oxide. Ordinary water is used as moderator as well as coolant. The

2 marks for



uranium elements are arranged in a particular lattice from inside the pressure vessel. The steam is generated in the reactor itself. Feed water enters the reactor vessel at the bottom and takes the heat produced in fission reaction and gets converted into steam.

explanation

- 6 e) Why overall efficiency of thermal power station is low? How can it be increased?

Ans:

Overall efficiency:

Overall efficiency is defined as the ratio of heat equivalent of electrical output to the heat of combustion. This efficiency for thermal plants is about 29%. There are many losses occurring in steam power plants. Losses in boiler house, in dry flue gases, ash and unburnt carbon, moisture in gases, unknown causes lead to 16% heat loss. Heat rejected to condenser, alternator losses are about 55%. So overall efficiency is very poor.

2 marks

Efficiency Improvement:

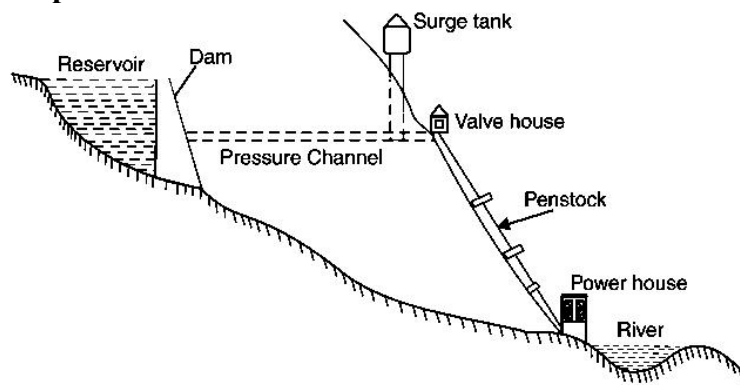
This efficiency can be improved by increasing the temperature and pressure of steam entering the turbine. Also by reducing the pressure in condenser, efficiency can be increased. Use of super heaters , economizers and pre-heaters increase thermal efficiency.

2 marks

- 6 f) Explain schematic arrangement of hydro-electric power station with diagram.

Ans:

Hydro-electric power station:



2 marks for
diagram

Schematic arrangement of a Hydro-electric plant

The main requirement of hydroelectric plant is the availability of water in huge quantity at sufficient head. An artificial storage reservoir is formed by constructing a dam across a river. Pressure tunnel is taken off from the reservoir to the valve house at the start of the penstock. The valve house contains main sluice valve for controlling water flow to the power station and automatic isolating valves for protection. A surge tank is provided for regulation of water pressure. Penstock carries water from surge tank to the turbine which is coupled with alternator. The kinetic energy of water flow is converted into mechanical energy by turbine and this mechanical energy is converted into electrical energy. Water after doing useful work is discharged to the tailrace.

2 marks for
explanation