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ME8792 POWER PLANT ENGINEERING

QUESTION BANK

UNIT I - COAL BASED THERMAL POWER PLANTS

1. What is stoker? Classify it. (A/M 17)

Stokers are used to feed solid fuels into the furnace in medium and large size power plants. It is classified into overfeed and underfeed stoker.

2. What is a super critical boiler? Give two advantages. (A/M 13, 18, N/D 15)

A supercritical boiler is a type of boiler that operates at supercritical pressure, frequently used in the production of electric power. A supercritical boiler operates at pressures above the critical pressure 22 MPa in which liquid water immediately becomes steam. Water passes below the critical point as it does work in a high pressure turbine and enters the generator's condenser, resulting in slightly less fuel use and therefore less greenhouse gas production.

Advantages:

- Higher unit cycle efficiency (40 - 42%)
- Lower heat rate and electricity generation cost is lower
- Lower water losses because no continuous blow down
- Reduced auxiliary power consumption.

3. What is pulveriser and why it is used? (M/J 14, N/D 13, 15)

The pulveriser is used to pulverise the coal in order to increase the surface exposure. Pulverised coal enables rapid combustion. The different types of pulverising mills are

1. Ball mill
2. Hammer mill
3. Ball and race mill.

4. What are the functions of draught system? (or) What are the purposes of Draught? (or) What do you understand by the term boiler draught? (M/J 16, N/D 16, 18)

Draught is defined as a small pressure difference required between the fuel bed (furnace) and outside air is to maintain constant flow of air and to discharge the gases through chimney to the atmosphere. The uses of draught in thermal power plants are

- To supply required quantity of air to the furnace for combustion of fuel.
- To draw the combustion products through the system.
- To remove burnt products from the system.

5. Define steam rate and heat rate. (N/D 16)

Steam rate: It is defined as the rate of steam flow required for producing unit shaft output. **Heat rate:** It is defined as heat input needed to produce one unit of power output. It indicates the amount of fuel required to generate one unit of electricity.

6. State some advantages of fluidized bed boilers. (N/D 14)

Any type of fuel - solid, liquid (or) gaseous fuel (or) domestic and industrial waste can be used in FBC system. Any type- of combustible matter can be burned by adjusting the factors as size, air velocity and rate of feed.

- High heat transfer rate is possible to the surfaces immersed in the bed, because solid mixing is extremely possible.
- High combustion efficiency.
- The solid fuel need not be pulverised in fluidised bed boilers.

7. What is the principle of cogeneration? (N/D 18)

Cogeneration is the combinations of heat and power (CHP). The power plant generates electricity and useful heat at the same time.

8. Define compounding of steam turbines. (A/M 17)

Compounding of steam turbines is the method in which energy from the steam is extracted in a number of stages rather than a single stage in a turbine.

9. Why majority of coal based thermal power plants are located near Seashore? (N/D 17)

Sea water is used for cooling purposes and also coal transportation through ship.

10. Reason out why Cogeneration is quite viable in Sugar industries compared to that in other industries. (N/D 17)

Byproduct Sugarcane molasses is available in sugar industries. It is used as a fuel in cogeneration unit.

UNIT II - DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS

1. What are the applications of Diesel engine power plants? (A/M 17, N/D 14)

- (a) It is quite suitable for mobile power generation
- (b) It is used as peak load plants in combined with thermal or hydro plants
- (c) It is used as stand by plants for emergency service.

2. What are the applications of gas turbine power plants? (A/M 18)

- (a) Peak load plants: gas turbine power plants are used to supply peak loads in steam or hydro plants
- (b) Standby plants: They are used as Standby plants for hydro – electric plants
- (c) They are used in industries for driving compressors & electric generators
- (d) They are used in Jet planes, aircrafts & ships.

3. What are the advantages of closed cycle gas turbine over open cycle gas turbine? (N/D 18)

Merits:

- (i) Efficiency is same throughout the cycle
- (ii) The turbine blades do not wear away since the combustion is external
- (iii) Starting of the plant is easy
- (iv) Low quality fuel can be used since the combustion is external.

Demerits:

- (i) A separate pre cooler arrangement is necessary
- (ii) The size & weight are more
- (iii) Initial cost & maintenance cost are more
- (iv) Combustion efficiency is less.

4. What is reheating and regeneration of gas turbine? (N/D 14, 16)

If the dryness fraction of steam leaving the turbine is less than 0.88, then, corrosion and erosion of turbine blades occur. To avoid this situation, reheat is used. In the simple open cycle system the heat of the turbine exhaust gases goes as waste. To make use of this heat a regenerator is provided. In the regenerator the heat of the hot exhaust gases from the turbine is used to preheat the air entering the combustion chamber.

5. Name the various “gas power cycles”. (N/D 16)

- Otto cycle
- Diesel cycle
- Dual cycle

6. What are the different types of lubrication system in diesel power plant? (M/J 14)

- Mist lubricating system
- Wet sump lubrication system
- Dry sump lubrication system

7. Why power generation by gas turbine is more attractive than other turbines? (N/D 15)

Gas turbine power plant is attractive because of their ability to quickly ramp up power production

8. List down the various processes of the Brayton cycle. (A/M 17)

- Isentropic compression
- Constant pressure heat addition
- Isentropic expansion
- Constant pressure heat rejection

9. Name the essential components of a diesel electric plant. (M/J 16)

1. Diesel engine
2. Air intake system
3. Exhaust system
4. Fuel system
5. Cooling system
6. Lubricating system

10. Mention the major difference between Otto cycle and diesel cycle. (N/D 15)

S.NO	Otto cycle	Diesel Cycle
1	Otto cycle consists of two isentropic and two constant volume processes.	Diesel cycle consists of two isentropic and one constant volume and one constant pressure process
2	Heat addition takes place at constant volume	Heat addition takes place at constant pressure
3	Compression ratio is equal to expansion ratio	Compression ratio is greater than expansion ratio

UNIT III - NUCLEAR POWER PLANTS

1. What is the function of control rods in nuclear reactor? (A/M 17, N/D 15)

The control rods are used to start the chain reaction, maintain the chain reaction at required level and to shut down the reactor during emergency.

2. What is the function of pressurizer in PWR? (A/M 17, N/D 18)

Pressurizer maintains the high pressure in the primary circuit. It prevents boiling in the reactor.

3. List out the important components of a nuclear reactor. (A/M 18)

1. Nuclear fuel
2. Moderator
3. Control rods

4. Reflectors
5. Reactor vessel
6. Biological shielding
7. Coolant

4. Define “electron Volt” with reference to Nuclear Power Plants. (N/D 17)

It is defined as the amount of energy one electron gains by moving through a potential difference of one volt.

5. How do you cater for safety of nuclear power plant? (M/J 14, N/D 15)

- a. Radiological protection of workers
- b. Dose limit
- c. Radioactive waste management

6. What is breeding in nuclear reactor? (N/D 14)

The process of producing fissionable material from a fertile material such as uranium 238 (U238) and thorium 232 (Th 232) by neutron absorption is known as breeding.

7. Why shielding is necessary in nuclear power plants? (N/D 16)

During fission of nuclear fuel, alpha particles, beta particles, deadly gamma rays and neutrons are produced. Shielding is essential to protect the operating men from the harmful effects. A protection must be provided against them. Thick layers of lead or concrete are provided round the reactor for stopping the gamma rays. Thick layers of metals or plastics are sufficient to stop the alpha and beta particles.

8. Give typical examples for Control Rods. (N/D 17)

- Boron,
- cadmium
- hafnium are mostly used as control rods

9. What is CANDU type reactor? (M/J 16, N/D 18)

CANDU (Canadian –Deuterium-Uranium) reactor. These reactors use heavy water(deuterium oxide) as moderator and primary coolant as well as the neutron reflector and light water as secondary coolant. the Canadians have exported such reactors known as CANDU reactors. In this type of reactor the natural uranium is used as fuel. These reactors are more economical to those countries which do not produce enriched uranium, as the enrichment of uranium is very costly.

10. What do you understand by moderation? Why it is essential? (A/M 15)

To slow down neutrons from high velocities and hence high energy level which they have on being released from fission process so that probability of neutron to hit the fuel rods increases.

Main moderator used:

- Water H₂O
- Heavy water D₂O
- Graphite
- Beryllium

UNIT IV - POWER FROM RENEWABLE ENERGY

1. Enumerate the factors affecting the suitability of the site for the tidal power plant. (A/M 15)

- i) The location of the plant must be near the ocean
- ii) Site selection for the plant should be in such a way that tidal range of ocean is large
- iii) The sluice gates of dam should allow water to or from basins
- iv) There should also be a nearby demand for electricity, otherwise the energy which is produced has to be stored in some way or transported to where it is needed which increases the cost.

2. What is fuel cell? State the advantages. (A/M 17, 18)

It can be defined as an electrochemical device in which the chemical energy of a fuel is directly converted in to electrical energy.

Advantages

- (i) Water is the only discharge (pure H₂)
- (ii) High efficiency
- (iii) Low weight and volume
- (iv) Portable
- (v) No hazardous emissions

3. Name 2 types of Geothermal Energy Deposits. (N/D 17)

- i) Hydrothermal convective systems
- ii) Geo pressure resources
- iii) Petro thermal or Hot dry rocks,
- iv) Magma resources and
- v) Volcanoes.

4. Define the functions of surge tank in hydro plants. (M/J 16)

The surge tank is used to provide better regulation of water pressure in the system. The surge tank controls the water when the load on the turbine decreases and supplies water when the load on the turbine increases. Thus, surge tank controls the pressure variations resulting from the rapid changes in water flow in penstock and hence prevents water hammer.

5. What is biogas? Give the advantages. (N/D 16)

Biogas can be produced by anaerobic digestion of organic matter. Potential raw materials available on a large scale are cow dung, municipal waste and plants specially grown for this purpose like water hyacinth, algae and certain types of grasses. Biogas typically refers to a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen.

Advantages:

- It's a renewable energy source
- eco-friendly
- Reliable

6. Mention the various advantage of wind power. (N/D 15, 18)

1. Inexhaustible fuel source
2. No pollution
3. Excellent supplement to other renewable source
4. Its free

7. Define Tidal Range (N/D 17)

The tidal range is the vertical difference between the high tide and the succeeding low tide.

8. What is spillway? (A/M 17)

A spillway is a structure used to provide the controlled release of flows from a dam or levee into a downstream area, typically the riverbed of the dammed river itself. In the UK they may be known as overflow channels. Spillways ensure that the water does not overflow and damage or destroy the dam.

9. What are the limitations of tidal power plant? (N/D 15)

- i) The tidal ranges are highly variable & therefore, turbines have to work on a wide range of head variation.
- ii) Construction in sea is found difficult.
- iii) More corrosion will occur due to corrosive sea water.

iv) The power transmission cost is high because the tidal power plants are located away from load centres.

10. Why is a tall tower essential for mounting a horizontal axis wind turbine? (M/J 16)

The wind speed increases with height. So, taller towers enable turbines to capture more energy and generate more electricity. Generally output power of the wind system increase

UNIT V - ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANT

1. What is fixed and operating cost? What are fixed costs in power plants? What includes fixed cost? (A/M 17, M/J 14,16, N/D 14)

Fixed costs are the cost required for the installation of complete power plant. Fixed cost includes the following cost: 1. Cost of land 2. Cost of building 3. Cost of equipment 4. Cost of installation, 5. Interest 6. Depreciation cost 7. Insurance 8. Management cost.

Operating cost includes the following cost. 1. Cost of fuel, 2. Cost of operating labour 3. Cost of maintenance, labours and materials. 4. Cost of supplier like Water for feeding boilers, for condenser and for general use.

2. List down the nuclear waste disposal methods. (A/M 17)

- (a) Utilizing underground facility
- (b) Injecting into deep aquifers
- (c) Deep bore holes
- (d) Rock melting

3. What do you understand by load duration curves? (M/J 14)

Load duration curves are Re arrangement of all load elements of load curve in the order of decreasing magnitude.

4. Define plant use factor. (N/D 16)

It is the ratio of energy produced in a given time to the maximum possible energy that could have been produced during the same period of operation.

5. Define demand factor. (N/D 14)

Demand factor is defined as the ratio of maximum demand to connected load. Connected load is the sum of ratings in kW of equipment installed in the consumer's premises. Maximum demand is the maximum load, which a consumer uses at any time.

6. Define load curve. (or) What is the significance of load curve? (A/M 13, N/D 15, 18)

Load curve is a graphical representation between load in kW and time in hours. It shows variation of load at the power station. The area under the load curve -represents the energy generated in a particular period. It shows the value of a specific load for each unit of the period covered. The unit of time considered may be hour, days, weeks, months or years.

7. What is main objective of tariff? (N/D 16)

Rates are the different methods of charging the consumers for the consumption of electricity. It is desirable to charge the consumer according to his maximum demand (kW) and the energy consumed (kWh). The tariff chosen should recover the fixed cost, operating cost and profit etc. incurred in generating the electrical energy.

8. What is the equipment used to control the particulates? (N/D 15)

- (i) Scrubbers
- (ii) Cyclone separator
- (iii) Electro static precipitator
- (iv) Fabric filters

9. Define ‘Green House Effect’. (N/D 17)

It is the process by which radiation from a planet’s atmosphere warms the planet’s surface to a temperature above what it would be without its atmosphere.

10. How ‘smog’ is defined? (N/D 17)

Smog caused by the action of solar ultraviolet radiation on atmosphere polluted with hydrocarbon and oxides of nitrogen.

PART B & C

UNIT I COAL BASED THERMAL POWER PLANTS

1. Explain the layout of steam power plant.(Nov-15,16)
2. List out the steps to be followed in coal handling systems and ash handling systems, Explain it. .(May-17,18, Nov-15,18)
3. Explain the condenser of thermal power plant. (May-13,16, Nov-14)
4. Explain the draught system in coal power plant. (May-13, Nov-14,15)
5. What is meant by Fluidized Bed Combustion (FBC)? Explain in detail about various FBC systems? (May-16,18, Nov-14,17,18)

UNIT II – DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS

1. With a neat sketch explain in detail about Diesel engine power plant.(May-15,16,19, Nov-14,16,17,18)
2. Mention the various methods of lubrication system and explain it.(Nov-14)
3. Gas Turbine power plant. (May-15,16,17, Nov-14,17)
4. Explain in detail about combined cycle power plant. (May-16,18, Nov-18)
5. Explain in detail about Integrated Gasification Combined Cycle. (May-16,17,19)

UNIT III – NUCLEAR POWER PLANTS

1. Write about nuclear fission.(May-17) & Write about chain reaction. (May-17, Nov-18)
2. With neat diagram, explain the various components of nuclear power plant. (May-15,19, Nov-15,16,17)
3. Explain the BWR and PWR with neat layout. (May-15,16, Nov-14,17,18)
4. Explain CANDU reactor with neat sketch. And also write its advantages and disadvantages. (Nov-15,16,17)
5. Discuss about safety measures adopted in nuclear power plant. (Nov-16,18)

UNIT IV– POWER FROM RENEWABLE ENERGY

1. Explain the hydroelectric power plant with neat layout. (May-17,18, Nov-14,15,16,18)
2. Explain the construction and working of wind mill. (May-15, Nov-16,18)
3. With neat diagram, explain the working of biogas plant. And also write its advantages and disadvantages. (May-17,18, Nov-15,18)
4. Write short notes about solar photovoltaic cell. (May-16,17, Nov-15)
5. Write short notes about Fuel cell. (May-16,18,19, Nov-15,16)

UNIT V– ENERGY ECONOMIC AND ENVIRONMENTAL ISSUES OF POWERPLANTS

1. What is meant by tariff? Explain the different types of tariff rate. (May-17,18 Nov-15,17,18)
2. Write about capital cost and operating cost of power plants. (May-16,18 Nov-14,17)
3. Explain the types of load. (May-16,17,18)

4. Explain the Site selection criteria for various power plants. (**May-16,18,19 Nov-14,16**)
5. Explain the control of emission from coal power plant. (**May-17, Nov-15,16,17,18**)