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Question Paper Code : 40795

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2024.

Fifth/Sixth/Seventh Semester

Mechanical engineering

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CME 384 – POWER PLANT ENGINEERING

(Common to : Mechanical Engineering (Sandwich))

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define supercritical boiler.
2. List the merits of pulverized fuel firing over stoker firing in a steam power plant.
3. Briefly explain the cooling system used in a thermal power plant.
4. List the components of a gas turbine power plant.
5. Classify the nuclear reactors on the basis of coolant used in the reactor.
6. What is the use of moderator in nuclear reactor?
7. Define the term penstock used in Hydroelectric power plant.
8. List the advantages of solar thermal power plant over the coal based power plants.
9. Give three important requirement of power tariff.
10. Classify the emissions from thermal power plants.

PART B — (5 × 13 = 65 marks)

11. (a) Discuss about the points to be considered for the selection of boilers for steam power plants.

Or

- (b) Explain the Hydraulic and Pneumatic ash handling system used in the coal based power plants.

12. (a) Explain the starting system used in large and medium sized diesel power plants.

Or

- (b) Design and explain the layout of a Combined Cycle Power Plant.

13. (a) With a neat diagram explain the working of pressurized water reactor (PWR).

Or

- (b) (i) Explain the breeding mechanism in nuclear power plants. (5)
(ii) Describe the India's three stage nuclear power programme. (8)

14. (a) Compare impulse and reaction turbines used in hydroelectric power plants with examples.

Or

- (b) Explain in detail the working of solar thermal power plant.

15. (a) Define the following terms :

- (i) Peak load (4)
(ii) Demand factor (4)
(iii) Load factor (5)

Or

- (b) (i) Describe the importance of nuclear waste management. (7)
(ii) Examine the Safety measures to be adopted for Nuclear Power plants. (6)

PART C — (1 × 15 = 15 marks)

16. (a) In a gas turbine power plant air is taken by the compressor at 15 °C and 1.01 bar, the pressure ratio of the cycle is 7. The maximum cycle temperature is 610 °C. Consider the flue gas expansion take place in two stages. The compressor is driven by high pressure (HP) turbine and low pressure (LP) turbine drives the power shaft. Take isentropic efficiencies of compressor and turbines are 82% and 85% respectively. By neglecting mass of fuel calculate the following,
- (i) The pressure and temperature of the gases entering the LP turbine
 - (ii) The net power developed by the unit per kg/s of mass flow
 - (iii) The work ratio of the cycle
 - (iv) The thermal efficiency of the cycle.

Assume, for air : specific heat = 1.005 kJ/kg K and $\gamma = 1.4$, for gas : specific heat = 1.15 kJ/kg K and $\gamma = 1.33$

Or

- (b) Using following data evaluate the cost of power generation per kWh.

Installed Capacity of the plant = 10 MW

Cost of plant = Rs. 1200 per kW

Interest, insurances and taxes = 5% per annum

Depreciation = 5%

Cost of primary distribution = Rs. 500000

Interest, insurances, taxes and depreciation for distribution = 5% per annum

Cost of coal = Rs. 4.5 per kg

Operating cost = Rs. 500000

Plant maintenance cost (Fixed) = Rs. 20000 per annum

Plant maintenance cost (Variable) = Rs. 30000 per annum

Maximum demand = 9000 kW

Annual load factor = 0.6

Coal consumption = 255000 kg per annum