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C037632(037)

B. Tech. (Sixth Semester) Examination, April-May 2022

(Scheme : AICTE)

(Mechanical Engg. Branch)

POWER PLANT ENGINEERING

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : *Part (a) from each unit is compulsory and carry 4 marks each. Attempt any* ***two*** *parts from (b), (c) and (d) and carry 8 marks each.*

Unit-I

1. (a) What is central power station? What are the importance of central power station?

(b) Explain the elements of modern steam power plant. Also describe the various circuits involved in power plant.

(c) Compare steam, hydro and nuclear power plant.

(d) Explain the primary and secondary electrical distribution system with neat diagram.

Unit-II

2. (a) Give the layout of a modern steam power plant and explain it briefly.

(b) Explain briefly the following methods of feed water treatment :

(i) Sodium zeolite process

(ii) Deaeration

(iii) Coagulation

(c) Explain the various stages of coal handling plant.

(d) A steam power plant with inlet steam to the h.p. turbine at 90 bar and 500°C and condensation of 40°C produces 500 MW. It has one stage of reheat optimally placed which raises the steam temperature back to 500°C. One closed feed water heater with drains cascaded back to the condenser receives bled steam at the reheat pressure, and the remaining steam is reheated and then expanded in the L.P. turbine. The H.P. and L.P. turbines have isentropic efficiencies of 92% and 90%, respectively. The

isentropic efficiency of the pump is 75%. Calculate (i) the mass flow rate of steam at turbine inlet in kg/s, (ii) the cycle efficiency, and (iii) the cycle work ratio. Use TTD = –1·6°C.

Unit-III

3. (a) Discuss the factors which should be considered while selecting a site for a hydroelectric plant.

(b) Give the layout of a diesel engine power plant and also discuss about the essential components of a diesel power plant.

(c) A four-stroke CI engine of 3·5 litre capacity develops indicated power on average of 13·1 kW/m^3 of free air induced per minute, while running at 3600 rpm and having a volumetric efficiency of 82 per cent, referred to free air conditions of 1·013 bar and 25°C. A blower driven mechanically from the engine is proposed to be installed for supercharging. It works through a pressure ratio of 1·75 and has an isentropic efficiency of 70 per cent. Assume that at the end of the intake stroke the cylinders contain a volume of charge equal to the swept volume, at the pressure and temperature of the delivered air from the blower. Taking all mechanical efficiencies to be

80 per cent, estimate the net increase in brake power of the engine due to supercharging.

(d) In a hydro-electric power plant the reservoir is 225 m above the turbine house. The annual replenishment of reservoir is $3 \cdot 5 \times 10^{12}$ N. Calculate the energy available at the generating station bus bars if the loss of head in the hydraulic system is 25 m and the overall efficiency of the system is 85%. If maximum demand of 45 MW is to be supplied determine the diameter of two steel penstocks.

Unit-IV

4. (a) What do you mean by the term Radioactivity? What is the difference between Artificial radioactivity and Natural radioactivity?

(b) Explain briefly the following :

(i) Photoneutrons

(ii) Activation neutrons

(iii) Prompt-fission gamma rays

(iv) Fission-product-decay gamma rays

(v) Half life

(vi) Average (mean) life

(vii) Elastic scattering

(viii) Inelastic scattering

(c) Explain gas cooled reactor power plant with suitable diagram. Also give its advantages and disadvantages.

(d) The half-life or Radon gas is 3·83 days. What is its radioactive decay constant? What percentage of the radon atoms originally present will decay in a period of 45 days.

Unit-V

5. (a) Define load factor, demand factor, plant capacity factor and plant diversity factor.

(b) What do you mean by depreciation? Enumerate and explain briefly various methods used to calculate the depreciation cost.

(c) A power station has to supply load as follows :

Time (hours)	0-6	6-12	12-14	14-18	18-24
Load (MW)	30	90	60	100	50

(i) Draw the load curve.

(ii) Draw the load duration curve.

(iii) Select suitable generating units to supply the load.

(iv) Calculate the load factor.

(v) Calculate the capacity of the plant and the plant capacity factor.

(d) A diesel electric station has 4-generating sets, each of 500 kW and 1 of 400 kW capacity. The other data is given below :

Maximum demand	:	1500 kW
Load factor	:	0·5
Capital cost	:	Rs. 10000/kW

Annual cost (interest + depreciation + insurances and taxes) 16% of capital cost

Annual maintenance cost	:	Rs. 45000
Operation cost	:	Rs. 8000
Fuel used	:	0·45 kg/kWh
Cost of fuel	:	Rs. 8/kg
Lubricating oil used	:	0.0024 kg/kWh
Cost of lubricating oil	:	Rs. 45/kg
Calorific value of fuel used	:	41000 kJ/kg
Generator efficiency	:	90%

Determin the following :

(i) The rating of diesel engine

(ii) Energy produced per year

(iii) Cost of generation, Rs/kWh, and

(iv) Overall efficiency of the plant.