

Reg. No. :

J 3320

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2009.

Sixth Semester

Mechanical Engineering

ME 1354 — POWER PLANT ENGINEERING

(Common to B.E. (Part-Time) Fifth Semester Regulation 2005)

Time : Three hours

Maximum : 100 marks

Use of standard charts and tables are allowed.

Any missing data can be assumed suitably.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give the requirements of chain reaction.
2. Why is the maximum cycle temperature of gas turbine plant much lower than that of diesel power plant?
3. What is the necessity of draft tubes? List the types.
4. What is the significance of specific speed of hydraulic turbines?
5. Distinguish between fouling and slagging.
6. List the advantages of balanced draft system.
7. What is meant by seeding in MHD systems?
8. Mention the problems in solar thermal central receiver systems.

9. List down the nuclear waste disposal methods.
10. What are the components of tidal power plants?

PART B — (5 × 16 = 80 marks)

11. (a) (i) A gas turbine draws in air from atmosphere at 1 bar and 25°C and compresses it to 5 bar. The air is heated to 1250 K at constant pressure and then expanded through two stages in series back to 1 bar. The high pressure turbine is connected to the compressor and produces just enough power to drive it. The low pressure stage is connected to an external load and produces 82 kW of power. Calculate the mass flow of air, the inter-stage pressure of the turbines and the thermal efficiency of the cycle. Assume $\gamma = 1.4$ and $C_p = 1.005$ kJ/kg K for both the turbines and the compressor. Neglect the increase in mass due to the addition of fuel for burning. (8)
- (ii) Explain about Velox boiler with neat sketch. (8)

Or

- (b) (i) Steam enters the high pressure turbine at 12 MPa and 600°C and is condensed in the condenser at a pressure of 10 kPa. If the moisture content of steam at the exit of low pressure turbine is not to exceed 12%. Determine pressure at which the steam should be reheated and thermal efficiency of the cycle. (8)
- (ii) Discuss in detail about FBC boiler. (8)
12. (a) (i) Discuss about pulverized coal handling system. (5)
- (ii) Explain the working of spreader stoker. (5)
- (iii) What are the factors affect the performance of electrostatic precipitator? Explain. (6)

Or

- (b) (i) Calculate the height of chimney required to produce a draught equivalent to 20 mm of water if the flue gas temperature is 260°C and ambient temperature is 27°C and the stoichiometric air requirement is 18 kg per kg of fuel. Assume 50% excess air for combustion. (6)
- (ii) Write short notes on the following:
- (1) Requirements of surface condensers.
- (2) Forced draft and induced draft cooling towers. (10)

13. (a) (i) What are the desirable properties of a good moderator? (4)
 (ii) Explain about sodium cooled reactor with a neat sketch. (8)
 (iii) What are the advantages and disadvantages of breeder reactor? (4)

Or

- (b) (i) Discuss in detail about the factors affect which affect the selection of hydraulic turbines. (6)
 (ii) How do you govern the Francis turbine? (6)
 (iii) Describe — Muschel curves. (4)

14. (a) (i) Brief about the performance evaluation of diesel power plant. (4)
 (ii) A cooling tower is required for a diesel power to cool 1200 litres of water at 70°C. The DBT and WBT of atmospheric air are 28°C and 23°C respectively. A forced draft tower with 75% efficiency is used for cooling. Calculate the fan power. Assume that air goes out of tower at 60°C and 90% RH. (7)
 (iii) Explain about the essential components of diesel power plant. (5)

Or

- (b) (i) A gas turbine draws in air from atmosphere at 1 bar and 300 K and compresses it to 6.5 bar. The air is heated to 1350 K at constant pressure and then expanded through two stages in series back to 1 bar. The high pressure turbine is connected to the compressor and produces just enough power to drive it. Assume $\gamma = 1.4$ and $R = 0.287$ kJ/kg K for both the turbine and compressor. Neglect the increase in mass due to the addition of fuel for burning. Calculate the following for a mass flow of 1 kg/s, the inter-stage pressure, the net power output, and the thermal efficiency of the cycle. (9)
 (ii) What are the methods to improve the efficiency of the gas turbine power plants? (3)
 (iii) What are the advantages of repowering cycle? (4)

15. (a) (i) From the following data, calculate the generation cost and reserve capacity of thermal power plant: Installed capacity = 175 MW; Annual load factor = 60%; Capital cost = Rs. 950 crores; Annual cost including salaries = 15% of annual cost; Rate of interest = 8.5%; Rate of depreciation = 9%; Auxiliary power consumption = 6% of power generation. (6)
 (ii) Explain working of hybrid OTEC system and what are the advantages? (6)
 (iii) Calculate the average power available for one tidal period if the surface area is 1,50,000 m² and the range of tide is 10.25 m. (4)

Or