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Question Paper Code : 80999

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Fifth/Sixth/Seventh Semester

Mechanical Engineering

CME 390 — THERMAL POWER ENGINEERING

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List the types of solid fuels with one example each.
2. State the difference between gross and net calorific value.
3. Mention two differences between fire-tube and water-tube boilers.
4. Name any four mountings used in a steam boiler.
5. Define volumetric efficiency of an air compressor.
6. List two advantages of using multistage air compressors.
7. Define sub-cooling in vapor compression refrigeration.
8. Identify any two applications of thermoelectric refrigeration.
9. State the significance of the dry bulb temperature.
10. Mention any four types of air conditioning systems.

PART B — (5 × 13 = 65 marks)

11. (a) Explain the process of determining the ultimate analysis of a fuel and interpret its relevance.

Or

- (b) (i) Classify different types of fuels with examples. (6)
- (ii) Compare their characteristics in terms of calorific value, storage, and environmental impact. (7)

12. (a) Classify various types of boilers used in thermal power systems and list their distinguishing features.

Or

- (b) Discuss the working and significance of accessories like economizer and super heater in a boiler.
13. (a) Explain how clearance volume affects the performance of a reciprocating compressor.

Or

- (b) Describe and compare the working principles of rotary and reciprocating compressors.
14. (a) Discuss the effect of superheating on the performance of vapor compression systems.

Or

- (b) Compare the working principles of vapour absorption and air cycle refrigeration systems.
15. (a) It is required to design an air-conditioning system for an industrial process for the following hot summer conditions:

Outdoor conditions..... 32°C DBT and 65% R.H.

Required air inlet conditions..... 25°C DBT and 60% R.H.

Amount of free air circulated..... $250\text{ m}^3/\text{min}$

Coil dew temperature..... 13°C

The required condition is achieved by first cooling and dehumidifying and then by heating.

Calculate the following :

- (i) The cooling capacity of the cooling coil and its by-pass factor.
- (ii) Heating capacity of the heating coil in kW and surface temperature of the heating coil if the by-pass factor is 0.3.
- (iii) The mass of water vapour removed per hour.

Solve this problem with the use of psychrometric chart.

Or

- (b) It is required to design an air-conditioning plant for a small office room for following winter conditions :

Outdoor conditions.....14°C DBT and 10°C WBT

Required conditions....20°C DBT and 60% RH.

Amount of air circulation....0.30 m³/min./person.

Seating capacity of office.....60.

The required condition is achieved first by heating and then by adiabatic humidifying

Determine the following

- (i) Heating capacity of the coil in kW and the surface temperature required if the by pass factor of coil is 0.4.
- (ii) The capacity of the humidifier.

Solve the problem by using psychrometric chart.

PART C — (1 × 15 = 15 marks)

16. (a) Propose design improvements to a two-stage air compressor system with intercooling to enhance efficiency, and evaluate the energy-saving potential with justification.

Or

- (b) Analyze how different psychrometric processes-such as sensible cooling, dehumidification, and evaporative cooling-are integrated in modern air-conditioning systems to meet varying environmental demands.

