Reg. No. : | | | | | | | | | | |

Question Paper Code : P 1405

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2009.

Third Semester

Mechanical Engineering

ME 1201 — ENGINEERING THERMODYNAMICS

(Common to Production Engineering)

(Common to B.E. (Part-Time) – Second Semester – Mechanical Engineering – Regulation 2005)

(Regulation 2004)

Time : Three hours Maximum : 100 marks

(Use of standard thermodynamic tables, Mollier diagram, Psychrometric chart and Refrigerant property tables permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by Continuum? Identify its importance.

2. What is the requirement for the thermal equilibrium? Which law governs it?

3. Classify the following as point or path function : Heat, Enthalpy, Displacement work, Entropy.

4. Why is the COP of an heat pump is higher than that of a refrigerator, if they both operate between the same temperature limits?

5. What is the triple point of water? Give the values of properties at that point.

6. What is meant by latent heat of vaporization?

7. Is water vapour an ideal gas? Why?

8. If atmospheric air (at 101325 Pa) contains 21% oxygen and 79% nitrogen (vol. %), what is the partial pressure of oxygen?

9. If the vapour pressure in the open atmosphere is 2.38 kPa atmospheric pressure is 100 kPa, calculate the specific humidity.

10. How do relative humidity, specific humidity, dew point temperature and wet bulb temperature change during sensible cooling?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Distinguish between the reversible process and the cyclic process. (4)

(ii) Air contained in the cylinder and piston arrangement comprises the system. A cycle is completed by four process 1-2, 2-3, 3-4 and 4-1. The energy transfers are listed below. Complete the table and determine the network in kJ. Also check the validity of the first law of thermodynamics. (8 + 2 + 2)

Process	Q (kJ)	W (kJ)	∇ U (kJ)
1-2	40	?	25
2-3	20	–10	?
3-4	–20	?	?
4-1	0	+8	?

Or

(b) (i) Derive the suitable expression for the ideal compressor from the steady flow energy equation and specify the assumptions under which such equation is applicable. (4)

(ii) Calculate the power developed and diameter of the inlet pipe, if a gas enters into the gas turbine at 5 kg/s, 50 m/s with an enthalpy of 0.9 MJ/kg and leaves at 150 m/s with an enthalpy of 0.4 MJ/kg. The heat loss to the surrounding is 0.025 MJ/kg. Assume 100 kPa and 300 K at the inlet. (8 + 4)

12. (a) (i) Deduce the efficiency of Carnot cycle in terms of temperature from its p-V diagram. (4)

(ii) Air is compressed from 100 kPa and 300 K to 5 bar isothermally and then it receives heat at constant pressure. It is finally returns to its initial condition by a constant volume path. Plot the Cycle on p-V and T-s diagram and calculate the net heat and work transfer. (2 + 2 + 4 + 4)

Or

(b) (i) Bring out the concept of the Entropy and importance of T-s diagram. (4)

(ii) Five kg of water at 303 K is mixed with one kg of ice at 0°C. The system is open to atmosphere. Find the temperature of the mixture and the change of entropy for both ice and water. Assume Cp of water as 4.18 kJ/kg-K and Latent heat of ice as 334.5 kJ/kg. Comment on the result based on the principle of increase in entropy. (4 + 4 + 4)

13. (a) (i) What is dryness fraction and degree of superheat? (4)

(ii) Wet steam of 0.5 MPa and 95 % dry occupies 500 litres of volume. What is its internal energy? If this steam is heated in a closed rigid vessel till the pressure becomes 1 MPa, find the heat added. Plot the process on the Mollier chart. (5 + 5 + 2)

Or

(b) A regenerative cycle with three open feed water heaters works between 3 MPa, 450°C and 4 kPa. Assuming that the bleed temperatures are chosen at equal temperature ranges, plot the process on h-s diagram and determine the efficiency of the cycle.

14. (a) (i) State the equation of state for van der wall's gas and explain the importance of each term. Also bring out the limitations of the equation. (3 + 3 + 2)

(ii) A gas mixture consists of 12 kg of methane, 5 kg of nitrogen and 3 kg of oxygen. Determine the molecular mass and gas constant of the mixture. If the total pressure is 100 kPa, calculate their partial pressures. (3 + 3 + 2)

Or

(b) (i) What is compressibility factor? Explain its significance. (2 + 2)

(ii) Deduce the expression for the Joule Thomson coefficient and hence plot the variation of temperature with pressure for various enthalpies, marking all zones and boundaries. (8 + 4)

15. (a) (i) Deduce the relationship for specific humidity in terms of total pressure and vapour pressure. (4)

(ii) If a room of 75 m^3 contains air at 25°C and 100 kPa at 75%r relative humidity, determine the partial pressure of dry air, specific humidity, enthalpy, mass of dry air and water vapour in the room. (3 + 3 + 3 + 3)

Or

(b) (i) How is the ratio of dry air flows related to specific humidity and enthalpy in an adiabatic mixing? (4)

(ii) In a power plant, cooling water leaves the condenser and enters a wet cooling tower at 35°C at a rate of 100 kg/s. water is cooled to 22°8C in the cooling tower by air that enters the tower at 101.325 kPa and 20°C and 60% relative humidity and leaves saturated at 30°C. Neglecting the fan power, determine the volume flow rate of air in to the cooling tower and mass flow rate of the required make up water. (8+4)
