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

R 3449

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Third Semester

(Regulation 2004)

Mechanical Engineering

ME 1201 — ENGINEERING THERMODYNAMICS

(Common to Production Engineering)

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

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 — ($10 \times 2 = 20$ marks)

1. What is a PMM1? Why is it impossible?

2. Is it correct to say 'total heat' or 'heat content' of a closed system?

3. Why the second law of thermodynamics is called a directional law of nature?

4. The coefficient of Performance (COP) of a heat pump is 5. Find the COP of a refrigerator if both are reversible devices interacting between same source temperature and sink temperature.

5. Define saturation state of a system.

6. Why Carnot cycle is not practicable for a steam power plant?

7. What do you mean by equation of state?

8. State the Dalton's law of partial pressure.

9. Define dew point temperature

10. What is sensible heating?

PART B — (5 × 16 = 80 marks)

11. (a) (i) A blower handles 1 kg/sec of air at 293 K and consumes a power of 15 kW. The inlet and outlet velocities of air are 100 m/sec and 150 m/sec respectively. Find the exit air temperature, assuming adiabatic conditions. Take Cp of air as 1.005 kJ/kg-K. (9)

(ii) A room for four persons has two fans, each consuming 0.18 kW power and three 100 W lamps. Ventilation air at the rate of 0.0222 kg/sec enters with an enthalpy of 84 kJ/kg and leaves with an enthalpy of 59 kJ/kg. If each person puts out heat at the rate of 0.175 kJ/sec, determine the rate at which heat is to be removed by a room cooler, so that a steady state is maintained in the room. (7)

Or

(b) (i) One litre of hydrogen at 273 K is adiabatically compressed to one-half of its initial volume. Find the change in temperature of the gas, if the ratio of two specific heats for hydrogen is 1.4 (4)

(ii) The velocity and enthalpy of fluid at the inlet of a certain nozzle are 50 m/sec and 2800 kJ/kg respectively. The enthalpy at the exit of nozzle is 2600 kJ/kg. The nozzle is horizontal and insulated so that no heat transfer takes place from it. Find

(1) Velocity of the fluid at exit of the nozzle

(2) Mass flow rate, if the area at inlet of nozzle is 0.09 m^2

(3) Exit area of the nozzle, if the specific volume at the exit of the nozzle is 0.495 m^3/kg. (12)

12. (a) (i) Give the Clausius statement of second law. (3)

(ii) A house hold refrigerator is maintained at a temperature of 275 K. Every time the door is opened, warm material is placed in side, introducing an average of 420 kJ, but making only a small change in the temperature of the refrigerator. The door is opened 20 times a day, and the refrigerator operates at 15% of the ideal COP. The cost of work is Rs 2.50 per kWhr. What is the bill for the month of April for this refrigerator? The atmosphere is at 303 K. (13)

Or

(b) (i) What is a thermal energy reservoir? (3)

(ii) Establish the inequality of Clausius. (13)

13. (a) A cyclic steam power plant is to be designed for a steam temperature at turbine inlet of 633 K and an exhaust pressure of 8 kPa. After isentropic expansion of steam in the turbine, the moisture content at the turbine exhaust is not to exceed 15%. Determine the greatest allowable steam pressure at the turbine inlet, and calculate the Rankine cycle efficiency for these steam conditions. Estimate also the mean temperature of heat addition. (16)

Or

(b) In a reheat steam cycle, the maximum steam temperature is limited to 773 K. The condenser pressure is 10 kPa and the quality at turbine exhaust is 0.8778. Had there been no reheat, the exhaust quality would have been 0.7592. Assuming ideal processes, determine (i) reheat pressure (ii) the boiler pressure (iii) the cycle efficiency (iv) the steam rate. (16)

14. (a) (i) A certain gas has c_p = 0.913 and c_v = 0.653 kJ/kg K. Find the molecular weight and the specific gas constant R of the gas. (4)

(ii) Derive the Clausius- Clapreyon equation. (12)

Or

(b) (i) Derive Maxwell's equations. (11)

(ii) Prove $T\,ds = C_V dT + T\,(\partial p/\partial T)_V\,dV$. (5)

15. (a) In a laboratory test, a sling psychrometer recorded dry bulb and wet bulb temperatures as 303 K and 298 K respectively. Calculate (i) vapour pressure (ii) relative humidity (iii) specific humidity (iv) degree of saturation (v) dew point temperature (vi) enthalpy of the mixture. (16)

Or

(b) (i) 1 kg of air at 313 K dry bulb temperature and 50% relative humidity is mixed with 2 kg of air at 293 K dry bulb temperature and 293 K dew point temperature. Calculate the temperature and specific humidity of the mixture. (10)

(ii) Show the following processes on a skeleton psychrometric chart

(1) dehumidification and cooling

(2) heating and humidification (6)
