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**B.E / B.Tech ( Full Time ) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2013**

INDUSTRIAL ENGINEERING

IV Semester

**ME 9215 Thermodynamics**

(Regulation 2008)

Time: 3 Hours — Answer ALL Questions — Max. Marks 100

(Use of Compressibility chart and HMT data book is permitted)

**PART-A (10 x 2 = 20 Marks)**

1. What is the difference between a closed system and an open system?
2. What do you understand by triple point of a pure substance?
3. What is a PMM1? Why is it impossible?
4. What are the causes of irreversibility of a process?
5. How do accessories differ from the mountings of a boiler?
6. What is the effect of delivery pressure of the refrigerant on the performance of vapour compression refrigeration system?
7. Show that for an ideal gas $c_p - c_v = R$
8. What are reduced properties?
9. What do you mean by critical radius of insulation?
10. What do you mean by a Grey body?

**Part – B ( 5 x 16 = 80 marks)**

11 Air flows steadily at the rate of 0.4 kg/s through an air compressor, entering at 6 m/s with a pressure of 1 bar and a specific volume of 0.85 $m^3$/ kg and leaving at 4.5m/s with a pressure of 6.9 bar and a specific volume of 0.16 $m^3$/ kg. The internal energy of the air leaving is 88 kJ/kg greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 59 W. Calculate the power required to drive the compressor and the inlet and outlet cross-sectional areas. (16)

12 a) (i) Establish the equivalence of Kelvin-Planck's and Clausius' statement. (8)

(ii) An inventor claims to have developed a heat engine that receives 750 kJ of heat from a source at 400 K and produces 250 kJ of network while rejecting the waste heat to a sink at 300 K. Is this a reasonable claim? (8)

**OR**

b) (i) Show that energy is a property of a system (8)

(ii) A mass of 8 kg gas expands within a flexible container so that the p-v relationship is of the form $pv^{1.2}$= constant. The initial pressure is 1000 kPa and the initial volume is 1 $m^3$. The final pressure is kPa. If the specific internal energy of the gas decreases by 40 kJ/kg, find the heat transfer in magnitude and direction. (8)

13 a) (i) Write any four differences between S.I. and C.I. engine. (4)

(ii) Explain the working principle of 4 stroke diesel engine with the neat diagrams. (12)

**OR**

b) (i) Write any four differences between fire tube and water tube boiler. (4)

(ii) Explain the working principle of aqua–ammonia vapour absorption refrigeration system with a neat diagram. (12)

14 a) A gas mixture consists of 0.5 kg carbon monoxide and 1 kg of carbon dioxide. Determine,

(a) the mass fraction of each component

(b) the mole fraction of each component

(c) the average molar mass and the gas constant of the mixture. (4+4+4+4)

**OR**

b) (i) Derive the Van der Walls equation in terms of reduced properties. (10)

(ii) Determine the compressibility for $O_2$ at (a) 100 bar and -70 °C, (b) 5 bar and 30°C. For $O_2$, $T_c$ = 154.88 K, $p_c$ = 50.6 bar. (3+3)

15 a) A furnace wall is made up of three layers of thicknesses 250 mm, 100 mm and 150 mm with thermal conductivities of 1.65, k and 9.2 W / m °C respectively. The inside is exposed to gases at 1250 °C with a convection coefficient of 25 W / m$^2$ °C and the inside surface is at 1100 °C, the outside surface is exposed to air at 25 °C with convection coefficient of 12 W / m$^2$ °C.

Determine

(i) The unknown thermal conductivity 'k'

(ii) The overall heat transfer coefficient

(iii) All surface temperatures.

(iv) Draw the thermal circuit. (4+4+4+4)

**OR**

b) (i) Water at 50 °C enters a 1.5 cm diameter and 3 m long tube with a velocity of 1 m/s. The tube wall is maintained at a constant temperature of 90 °C. Calculate the heat transfer coefficient and the total amount of heat transferred if the exit water temperature is 64 °C. (10)

(ii) Enumerate the three modes of heat transfer with an example each. (6)