CBCS SCHEME

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17ME33

Third Semester B.E. Degree Examination, June/July 2019
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Thermodynamics data hand book permitted.

Module-1

1 a. With examples briefly describe the terms:
i) Macroscopic approach
ii) Intensive properties
iii) Closed systems
iv) Quasistatic process. **(08 Marks)**

b. Define Zeroth law of thermodynamics and explain the concept of temperature measurement. **(04 Marks)**

c. A platinum wire is used as resistance thermometer. The wire resistance was found to be 10Ω and 16Ω at ice and steam points respectively and 30Ω at sulphur boiling point 444.6°C. Find the constants a and b in the equation $R = R_0 (1 + at + bt^2)$ where t in °C. Also find the resistance of the wire at 500°C. **(08 Marks)**

OR

2 a. Describe the similarities and dissimilarities between work and heat transfer. **(06 Marks)**

b. With the help of p-v diagrams, derive expressions for p-dv work for i) isothermal process ii) Polytropic process. **(06 Marks)**

c. A gas is initially at 100kPa and 6000 cm^3. The final volume is 2000 cm^3. Determine the moving boundary work for each of the following processes:
i) When P is proportional to V
ii) When P is inversely proportional to V
iii) PV^2 = constant. **(08 Marks)**

Module-2

3 a. With a neat sketch, explain Joule's experiment and hence define first law of thermodynamics. **(06 Marks)**

b. Briefly describe internal energy as a property of the system. **(04 Marks)**

c. Write SFEE and explain the terms. **(02 Marks)**

d. A steam nozzle is supplied with 40kg/min of steam at 15 bar. At the inlet V_1 = 1800m/min and v_1 = 0.15 m^3/kg, u_1 = 2600 kJ/kg and corresponding values at the exit are p_2 = 1 bar, v_2 = 1.7m^3/kg and u_2 = 2520 kJ/kg. Calculate the exit velocity. **(08 Marks)**

OR

4 a. Briefly explain the terms:
i) Thermal reservoir
ii) Refrigerator
iii) Heat pump
iv) Clausius statement of II law. **(08 Marks)**

b. With the help of p-v diagram, derive an expression for the efficiency of a Carnot cycle. **(06 Marks)**

c. A reversible engine with 40% efficiency discharges 1520 kJ of heat per minute at 27°C to a pond. Find the temperature of the source which supplies the heat to the engine and power developed by the engine. **(06 Marks)**

Module-3

5 a. Define the terms:
   i) Reversible process
   ii) Reversible heat engine
   iii) Irreversible process. **(06 Marks)**

b. Describe with a sketch heat transfer through a finite temperature difference is irreversible. **(06 Marks)**

c. A reversible heat engine operates between two reservoirs at temperatures of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40°C and -20°C. The heat transfer to the engine is 2000kJ and the network output of the engine refrigerator plant is 360kJ. Evaluate the heat transfer to the refrigerant and net heat transfer to the reservoir at 40°C. **(08 Marks)**

OR

6 a. With p-v diagram explain Clausius inequality. **(06 Marks)**

b. Explain the principle of increase of entropy. **(04 Marks)**

c. Show that entropy is the property of a system. **(04 Marks)**

d. 10 gram of water at 20°C is converted into ice at -10°C in a constant pressure process of 1 atmosphere. Calculate the change in entropy for the process. Take cp_{water} = 4.187 kJ/kg K, cp_{ice} = 2.093 kJ/kg K, LH of ice = 335 kJ/kg. **(06 Marks)**

Module-4

7 a. Represent available and unavailable energy as referred to a cycle with T-S diagrams. **(06 Marks)**

b. Explain the concept of second law efficiency. **(06 Marks)**

c. Calculate the decrease in available energy when 25kg of water at 95°C mix with 35kg of water at 35°C at constant pressure and the temperature of the surroundings being 15°C (Take cpw = 4.2 kJ/kgK). **(08 Marks)**

OR

8 a. Explain the terms:
   i) Triple point
   ii) Critical point
   iii) Sub cooled liquid
   iv) Quality of steam. **(06 Marks)**

b. With a neat sketch and h-s diagram explain throttling calorimeter. **(06 Marks)**

c. A vessel of volume 0.04m^3 contains a mixture of saturated water and saturated steam at a temperature of 250°C. The mass of the liquid present is 9kg. Find the pressure, mass, specific volume, enthalpy, entropy and internal energy. **(08 Marks)**

Module-5

9 a. Define:
i) Dalton's law of partial pressure.
ii) Amagt's law of additive volume
iii) Ideal gas **(06 Marks)**

b. Derive an expression for the change in entropy of an ideal gas. **(04 Marks)**

c. A gaseous mixture consists of 1kg of oxygen and 2kg of nitrogen at a pressure of 150kPa and a temperature of 20°C. Find:
i) Gas constant
ii) Molecular weight of the mixture
iii) Mole Fractions
iv) Partial pressures
v) Specific heats of the mixture. **(10 Marks)**

OR

10 a. Define:
i) Law of corresponding states
ii) Compressibility factor
iii) Real Gas. **(06 Marks)**

b. Write Vander Waal's equation of state and express the constants in terms of critical properties. **(06 Marks)**

c. The specific volume of CO_2 is $1m^3/kg$ at 100°C. Determine the pressure exerted by CO_2 using Vander Waal's equation and compare the results obtained if CO_2 is treated as an ideal gas. **(08 Marks)**

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