CBCS SCHEME

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15ME33

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Explain Microscopic and Macroscopic approaches to thermodynamics. **(06 Marks)**

b. State and explain zeroth law of thermodynamic. **(04 Marks)**

c. The temperature T on a thermometric scale is defined as T = alnK +b were a and b are constants. The values of K are found to be 1.83 and 6.78 at 0°C and 100°C respectively. Calculate the temperature for value of K = 2.42. **(06 Marks)**

OR

2 a. Obtain an expression for displacement adiabatic work (work done in an adiabatic process). **(06 Marks)**

b. Define heat and work with reference to thermodynamic point of view. **(04 Marks)**

c. A gas expands from an initial state where the pressure in 340KPa and the volume is 0.0425 m^3 to a final pressure of 136KPa. The relationship between the pressure and volume of the gas is PV^2 = constant. Determine the work done for this process. **(06 Marks)**

Module-2

3 a. Derive the steady flow energy equation for an open system. **(04 Marks)**

b. Show that the Kelvin – Planck and Clausiv's statement of the II law of thermodynamic are equivalent. **(06 Marks)**

c. A gaseous system undergoes three quasistatic processes in sequence. The gas initially at 5 bar 0.01m^3 is expanded at constant pressure. It is then further expanded according to the relation. $PV^{1.4}$ = C to 2 bar, 0.025m^3. The gas is then returned to the initial state during which process PV = constant calculate the work interaction in each of three process and the net work for the system. **(06 Marks)**

OR

4 a. Obtain a relation between COP's of a refrigerator and heat pump. **(06 Marks)**

b. State and explain the ideal Carnot cycle on P-V diagram. **(04 Marks)**

c. A series combination of two Carnot engines operates between the temperature of 180°C and 20°C. Calculate the intermediate temperature, if the engine produce equal amounts of work. **(06 Marks)**

Module-3

5 a. Explain the factors that render a process irreversible. **(06 Marks)**

b. Explain internal and external irreversibility with equation. **(04 Marks)**

c. A reversible engine operates between a source at 927°C and two sinks at 127°C and 27°C. The energy rejected at both the sinks is the same compute the engine efficiency. **(06 Marks)**

OR

6 a. State and prove Clausius inequality and hence define entropy. **(06 Marks)**

b. Plot and explain the Carnot cycle with help of temperature entropy diagram. **(04 Marks)**

c. A 10kg bar of cast iron initially at 400°C is quenched in a 20 litres water tank initially at 25°C. Assuming no heat transfer with the surroundings and no boiling away of liquid water calculate the net entropy change for the process. $C_{pcastiron} = 0.5, C_{pwater} = 4.187$ kJ/kg K. **(06 Marks)**

Module-4

7 a. Obtain an expression for maximum useful work for a system and control volume. **(06 Marks)**

b. Define Gibb's and Helmholtz functions and explain its significances. **(04 Marks)**

c. Exhaust gases leave an I.C engine at 750°C and 1 atm, after having done 450kJ per kg gas in the engine cylinder. Assume that the enthalpy of the gas is a function of temperature only and that $C_p = 1.1$ kJ/kg K. Assume the temperature of the surrounding to be 27°C. Calculate :

i) The available and unavailable parts of the energy in every kg gas discharged

ii) The ratio of available energy to start to the engine work. **(06 Marks)**

OR

8 a. Sketch and explain Throttling Calorimeter. **(08 Marks)**

b. Define the following terms : i) Dryness fraction ii) Latent heat iii) Total heat of wet steam iv) Superheated steam. **(04 Marks)**

c. Find the specific volume, enthalpy and internal energy of wet steam at 18 bar pressure and dryness fraction of 0.85. **(04 Marks)**

Module-5

9 a. Explain Dalton's law of partial pressure and Amagat's law of additive volumes with reference to ideal gas mixture. **(06 Marks)**

b. Derive an expression for internal energy and enthalpy of gaseous mixtures. **(04 Marks)**

c. A mixture of gases contains 1kg of CO_2 and 1.5kg of N_2. The pressure and temperature of the mixture are 3.5bar and 27°C. Determine for the mixture.

i) The mass and mole traction of each constituent gas

ii) Average molecular weight

iii) The partial pressures. **(06 Marks)**

OR

10 a. Explain the following :

i) Generalized compressibility chart

ii) Law of corresponding states

iii) Compressibility factor **(06 Marks)**

b. Derive Vander Waal's constants interms of critical properties. **(06 Marks)**

c. Determine the pressure exerted by CO_2 in a container of $1.5m^3$ capacities when it contains 5kg at 27°C.

i) Using ideal gas equations

ii) Using Vander Waal's equation. **(04 Marks)**

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