CBCS Scheme

USN | | | | | | | | | | 15MR33

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing one full question from each module.
2. Thermodynamic Data book is allowed.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Distinguish between: i) Microscopic and macroscopic approach in the study of thermodynamics; ii) Intensive and extensive properties; iii) Point function and path function; iv) Open system and closed system. **(08 Marks)**

b. Define Quasi: static process. A platinum resistance thermometer has resistance of 2.8Ω at 0°C and 3.8Ω at 100°C. Calculate the temperature when the resistance is 5.8Ω. The resistance of thermometer is given by $R = R_0 (1 + \alpha t)$, where R_0 is resistance at 0°C. **(08 Marks)**

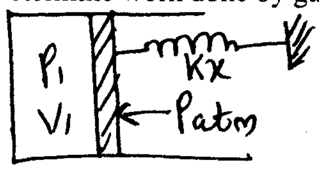
OR

2 a. Show that work is a path function. **(02 Marks)**

b. Derive an expression for displacement work in i) Isothermal process; ii) Polytropic process. **(06 Marks)**

c. Consider the system as shown in Fig.Q.2(c). Initial conditions of gas are $V_1 = 0.1m^3$, $P_1 = 200$ kPa. The ambient atmospheric pressure is 100kPa. The spring exerts a force which is equal to displacement from its equilibrium position. The gas is heated until its volume is doubled at which $P_2 = 600$ kPa. Determine work done by gas. **(08 Marks)**

Fig.Q.2(c)



Module-2

3 a. Derive the steady flow energy equation for a single stream of fluid entering and single stream of fluid leaving the control volume. State clearly the assumptions made. **(08 Marks)**

b. A stationary mass of gas is compressed without friction from an initial state of $0.3m^3$ and 0.105 MPa to a final state of $0.15m^3$ and 0.105 MPa the pressure remaining constant during the process. There is a transfer of 37.6 kJ of heat from the gas during the process. Find the change in internal energy of the gas. **(08 Marks)**

OR

4 a. Describe the working of Carnot's cycle, showing the cycle on P-V diagram and show that $\eta_{th} = 1 - \frac{T_2}{T_1}$. **(08 Marks)**

b. A reversible engine operates between temperatures. T_1 and T ($T_1 > T$). The energy rejected by this engine is received by a second reversible engine at the same temperature T. The second engine rejects heat at temperature T_2 ($T_2 > T$). Show that,

i) $T = \frac{T_1 + T_2}{2}$, if both engines produce same work output.

ii) $T = \sqrt{T_1 T_2}$, if both engines have same thermal efficiency. **(08 Marks)**

Module-3

5 a. State and prove Clausius inequality. **(08 Marks)**

b. 3kg of water at 90°C is mixed adiabatically with 4kg of water at 20°C in an isolated system. Calculate the total change in entropy due to mixing given specific heat of water = 4.187 kJ/kg K. **(08 Marks)**

OR

6 a. Explain the working of separating and throttling calorimeter with a neat sketch. **(08 Marks)**

b. 3 kg of steam at 18 bar occupies a volume of $0.225 m^3$ during a constant volume process to 10 bar. Determine: i) Final dryness fraction; ii) Final internal energy; iii) Change in entropy; iv) Workdone. **(08 Marks)**

Module-4

7 a. Obtain four Maxwell relations for a simple compressible system in the form,

$$\left(\frac{\partial M}{\partial y}\right)_x = \left(\frac{\partial N}{\partial y}\right)_y .$$

(08 Marks)

b. 0.5 kg of air is compressed reversibly and adiabatically from 80kPa, 60°C to 0.4 MPa and is then expanded at constant pressure and to the original volume. Sketch the processes on P-V and T-S planes. Compute the heat transfer and work transfer for the whole path. **(08 Marks)**

OR

8 a. Derive an expression for change in entropy of an ideal gas undergoing: i) An isobaric process; ii) Polytropic process. **(08 Marks)**

b. 1kg of air initially at 27°C is heated reversibly at constant pressure until the volume is doubled and then is heated at constant volume until the pressure is doubled. For the total path find: i) Work transfer; ii) Heat transfer; iii) Change in internal energy. **(08 Marks)**

Module-5

9 a. Explain the following:

i) Generalized compressibility chart; ii) Law of corresponding states.

iii) Compressibility factor; iv) Beatie-Bridgeman equation. **(08 Marks)**

b. Find the pressure exerted by methane in a container of capacity $2m^3$, when it contains 3kg at 300K using, i) Ideal gas equation; ii) Vander Waal's equation. **(08 Marks)**

OR

10 a. Derive Vander Waal's constants in terms of critical properties. **(08 Marks)**

b. A mixture of perfect gas at 20°C, has the following composition by volume, N_2 55%, O_2 20%, Methane 25%. If the partial pressure of methane is 0.5bar, determine:

i) Partial pressure of N_2 and O_2; ii) Mass fraction of individual gases.

iii) Gas constant for the mixture; iv) Molecular weight of the mixture. **(08 Marks)**

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