CBCS SCHEME

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18ME33

Third Semester B.E. Degree Examination, June/July 2023
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 handbook is permitted.***

Module-1

1 a. Define the following :
i) Closed system ii) Open system iii) Isolated system iv) Thermodynamics state **(08 Marks)**

b. State the Zeroth law of Thermodynamic and briefly explain its significance. **(04 Marks)**

c. The reading t_A and t_B of two Celsius thermometers A and B agree at the ice point (0°C) and the steam point (100°C) and are related by the equations $t_A = \ell + mt_B + t_B^2$. Between these two point ℓ, m, n are constants. When both are immersed in an oil bath. A indicates 55°C and B indicates 50°C. Determine the value of ℓ, m, n and also find the reading on A if B reads 25°C. **(08 Marks)**

OR

2 a. Mention the characteristics of thermodynamic properties. **(04 Marks)**

b. Classify the differences between microscopic and macroscopic approaches. **(06 Marks)**

c. The temperature t on a certain Celsius thermometer scale is given by means of a property through a relations $t = a \ln(P) + b$ where a and b are constant P is the property of the fluid. If, at the ice point and steam points the values of P are found to be 4 and 20 respectively. What will be temperature reading corresponding to a reading of P = 16? **(10 Marks)**

Module-2

3 a. List the difference between work and heat. **(06 Marks)**

b. Explain the path function and point functions. **(06 Marks)**

c. A stationary mass of a gas is compressed in a friction less way from 1 bar and $0.1m^3$ to 5 bar and $0.03m^3$. Assuming that the pressure and volume are related by Pr^n = constant, find the workdone on the gas. **(08 Marks)**

OR

4 a. Show that energy is a property of system. **(06 Marks)**

b. Derive the steady flow energy equations [SFEE] for a single stream of fluid entering and a single stream of fluid leaving the control volume. **(06 Marks)**

c. Air flows steadily through a rotary compressor. At entry the air is 20°C and 101KPa at exit the some air is at 200°C and 600KPa. Assuming the flow to be adabatic i) Evaluate the work done per unit mass of air if the velocities at inlet and exit are negligible ii) What would be the increase in work input if the velocities at inlet and exit are 50m/s and 110m/s. **(08 Marks)**

Module-3

5 a. State the limitation of first law of thermodynamics illustrate with example. **(04 Marks)**

b. State the Kelvin – Planks and Claudius statement of the second law of thermodynamics and prove their equivalence. **(08 Marks)**

c. A reversible heat engine operates between two reservoirs at temperature of 600°C and 40°C the engine drives a reversible refrigerator, which operates between 40°C and 20°C. The heat transfer to the engine is 2000kJ and network output from combined engine and refrigerator system is 360kJ. Calculate heat transfer and net heat transfer to the reservoir at 40°C. **(08 Marks)**

OR

6 a. State and prove Clasius inequality. **(06 Marks)**

b. Show that entropy is a property. **(06 Marks)**

c. $1.2m^3$ of air is heated reversibly at constant pressure from 300K and 600K and is then cooled reversibly at constant volume back to initial temperature. If the initial pressure is 1 bar, calculate net heat flow and overall change in entropy. Also represent the processes on T-S diagram. Take $C_p = 1.005kJ/Kg\ K$ and $R = 0.287kJ/Kg\ K$. **(08 Marks)**

Module-4

7 a. Explain briefly available and unavailable energies referred to a cyclic process. **(04 Marks)**

b. Derive an expression for available energy from a finite energy source at temperature T_1 when the surrounding temperature is T_0. **(08 Marks)**

c. A Carnot engine works between the temperature limits of 225°C and 25°C in which water issued as the working fluid, if heat is supplied to the saturated liquid water at 225°C until it is converted into saturated Vapoun, determine per Kg of water.

i) The amount of heat absorbed by the fluid
ii) The available energy
iii) The unavailable energy. **(08 Marks)**

OR

8 a. Draw a neat sketch of throttling calorimeter and explain how dryness fraction of steam is determined. Clearly explain its limitations. **(10 Marks)**

b. Define the following :
i) Triple point ii) Critical temperature iii) Dryness fraction iv) Saturation temperature v) Pure substances. **(10 Marks)**

Module-5

9 a. State and explain Amagat's law and Dalton's law of partial pressures. **(06 Marks)**

b. A tank of $0.1m^3$ capacity contains 1Kg of O_2, 0.9Kg of N_2, 1.5Kg CO_2, and 0.1 Kg of CO at 30°C. Determine :
i) The total pressure ii) Mole fractions of each gas iii) Gas constant "R" and Molecular weight M of the mixture. **(06 Marks)**

c. A gas mixture consists of 0.5Kg of Carbon monoxide and 1Kg of CO_2. Determine :
i) Mass fractions ii) Mole fraction of each component iii) The Avg. Molecular weight iv) the Gas constant of the mixture. **(08 Marks)**

OR

10 i) Compressibility factor
ii) Law of corresponding
iii) Compressibility chart
iv) Vender Waals equations of state
v) Beattie Bridge Man- equations. **(20 Marks)**

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