CBCS SCHEME

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18MR33

Third Semester B.E. Degree Examination, July/August 2022
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 Thermodynamic data hand book is permitted.

Module-1

1 a. Differentiate between the following with suitable examples:
i) Intensive and Extensive property.
ii) Open system and Isolated system
iii) Point function and path function. **(06 Marks)**

b. What is thermodynamic equilibrium? Explain the conditions of thermodynamic equilibrium. **(07 Marks)**

c. On some temperature scale 0°C is equivalent to 100°B and 100°C is equivalent to 300°B. Determine the temperature in °C corresponding to 200°B. Convert the temperature obtained in °C to Fahreheit and Kelvin scale. **(07 Marks)**

OR

2 a. Define work and heat in thermodynamics. Explain why neither is a property. **(08 Marks)**

b. A cylinder contains 1kg of a certain fluid at an initial pressure of 20bar. The fluid is allowed to expand reversibly behind a piston according to law PV^2 = constant until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regains its original position; heat is then supplied reversibly with the piston firmly locked in position until the pressure rises to original value of 20 bar. Calculate the network done by fluid, for an initial volume of $0.05m^3$. **(12 Marks)**

Module-2

3 a. State the first law of thermodynamics applied to cyclic and non cyclic process. **(05 Marks)**

b. Write the steady flow energy equation indicating all the terms in the equation. **(05 Marks)**

c. The inlet to a certain nozzle, the enthalpy of fluid passing is 3000 kJ/kg and the velocity is 60m/s. At the discharge end the enthalpy is 2762 kJ/kg. The nozzle is horizontal and there negligible loss from it.
i) Find the velocity at the exit from the nozzle.
ii) If the inlet area is $0.1m^3$ and specific volume at inlet is $0.187m^3$/kg find the mass flow rate.
iii) If the specific volume at the nozzle exit is $0.498m^3$/kg, find the exit area of the nozzle. **(10 Marks)**

OR

4 a. State Kelvin Plank and Clausius statement. Also prove they are equivalent. **(10 Marks)**

b. A reversible heat engines A and B are arranged in series rejecting heat to 'B' through intermediate reservoir. Engine 'A' receives 200kJ at a temperature of 421°C from a hot source, while engine 'B' is in equilibrium with a cold sink at a temperature of 4.4°C. If the work output of 'A' is twice that of 'B', find: i) the intermediate temperature between 'A' and 'B' ii) the efficiency of each engine iii) heat rejected to the cold sink. **(10 Marks)**

Module-3

5 a. State and prove Clausius inequality. **(10 Marks)**

b. $1.2m^3$ of air is heated reversibly at constant pressure from 300K to 600K and is then cooled reversibly at constant volume back to initial temperature. If the initial pressure is 1 bar, calculate:
   i) The net heat flow
   ii) The overall change in entropy
   iii) Represent the process on T-S plot. **(10 Marks)**

OR

6 a. Explain the following related to pure substance:
   i) Two property rule
   ii) Sub cooled or compressed liquid
   iii) Saturated liquid
   iv) Quality of steam. **(08 Marks)**

b. Draw phase diagram for pure substance and explain its salient features. **(06 Marks)**

c. A throttling calorimeter is used to measure the dryness fraction of the steam in the steam main has steam flowing at a pressure of 8 bar. The steam after passing through the calorimeter is at 1 bar pressure and 115°C, calculate the dryness fraction of the steam in the main $C_{pc} = 2.1$ kJ/kg K. **(06 Marks)**

Module-4

7 a. Explain the following:
   i) Maxwell relation ii) Clausius Clayperon's equation. **(10 Marks)**

b. Write the expression for entropy change during i) Isochoric ii) Isoboric process iii) Isothermal process. **(10 Marks)**

OR

8 a. Show that internal energy and enthalpy of an ideal gas are the function of temperature only. **(10 Marks)**

b. Air expanded irreversibly and adiabatically in a turbine from 800K and 1.5MPa to 540K. If this process had be reversible, the final temperature would have been 485K for same discharge pressure. Calculate the work per kg of air and change in entropy. Assume for air $C_v = 0.718$kJ/kg K and $\nu = 1.4$. **(10 Marks)**

Module-5

9 a. Derive an expression for gas constant (R) and molecular weight (M). **(06 Marks)**

b. Explain the following:
   i) Dal'ton law of partial pressure
   ii) Amagat's law of additive volume
   iii) Mass and mole fraction. **(06 Marks)**

c. A mixture of ideal gas consist of 3kg of N_2 5kg of CO_2 and at a pressure of 300kpa and temperature of 20°C. Find:
   i) Mole fraction of each constituent.
   ii) Equivalent gas constant of the mixture.
   iii) Equivalent molecular weight. **(08 Marks)**

OR

10 a. Derive an expressions for Vander Walls constants interms of critical points. **(12 Marks)**

b. One kg of Nitrogen at 430°C occupies $2.7m^3$. Compute the pressure of the gas using.
   i) Ideal gas equation
   ii) Vander Walls equation. **(08 Marks)**

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