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Third Semester B.E. Degree Examination, Dee'.2ilikian.2020
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: I. Answer ant' FIVE full questions, choosing ONE full question from each module.
2. Thermodynamics Hand Book permitted.

Module-1

a. Can you define and give examples to the following? i) Closed system, ii) open system, iii) isolated system. **(06 Marks)**

b. Can you distinguish between the following:
i) Microscopic and Macroscopic point of study
ii) Intensive and Extensive properties
iii) Work and Heat
iv) Path and Point functions. **(08 Marks)**

c. State and explain Zeroth law of thermodynamics. **(06 Marks)**

OR

2 a. Can you define thermodynamic definitions of work and heat? Write three important similarities between them. **(05 Nlarks)**

b. Can you derive expressions for work done of the following types of processes?
i) The process which follow the law, P = C
ii) The process which follow the law, $PV^7 = C$. **(06 Marks)**

c. Air at 1.02 bar, 22°C, initially occupying a cylinder volume of 0.015rn ^{3}, is compressed reversibly and adiabatically by a piston to a pressure of 6.8 bar. Calculate: i) The final temperature ii) The final volume iii) The work done. **(09 Marks)**

Module-2

3 a. Write the first law statements for a system undergoing:
i) a cycle ii) a process iii) a steady flow process. **(06 Marks)**

b. Prove that internal energy — a property. **(04 Marks)**

c. Air flows steadily at the rate of 0.4 kg/s through an air compressor, entering at 6 m/s with a pressure of l bar and a specific volume of 0.85 m ^{3}/kg, and learning at 4.5 m/s with a pressure of 6.9 bar and a specific volume of 0.16m ^{3}/kg. The internal energy of air leaving is 88kJ/kg greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 59 kJ/s. Calculate the power required to drive the compressor and the inlet and outlet pipe cross sectional areas. **(10 Marks)**

OR

4 a. Will you prove that two statements of second law of thermodynamics are equivalent? **(05 Marks)**

b. Can you explain cat not heat engine cycle with the help of P-V and T-S diagrams'? **(07 Marks)**

c. A heat source SI can supply 6000 kJ/min at 300°C and another heat source S2 can supply 60,000 kJ/min at 100°C. Which source between the two would you choose to supply energy to a carnot engine, that is to produce larger amount of power if the surroundings are at 27°C? Which engine is more efficient? **(08 Marks)**

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Module-3

5 a. Can you define and give examples for reversible and irreversible processes? List the factor which makes the process irreversible. **(06 Marks)**

b. Will you prove that entropy a property of a system? **(06 Marks)**

c. A reversible heat engine converts one-sixth of the heat input into work. When the temperature of the sink is reduced by 62°C, its efficiency is doubled. Find the temperature of the source and the sink. **(08 Marks)**

OR

6 a. Derive an expression for change in entropy during constant pressure process. **(06 Marks)**

b. Explain the principle of increase of entropy. **(06 Marks)**

c. **In** a shell and tube heat exchanger 45kg of water per minute is heated from 60°C to 115°C by hot gases which enter the heat exchanger at 225°C. If the flow rate of gases is 90 kg/min, find the net change of entropy of the universe. C_p (water) = 4.18 kJ/kg.K; C_p(gas) = 1 kJ/kg.k. Assume that there are no losses. **(08 Marks)**

Module-4

7 a. Define available and unavailable energy and prove that the available portion of heat Q withdrawn from an infinite source is (Q-T0As). Where T_o is dead state temperature and AS is change in entropy during the process. **(07 Marks)**

b. Obtain an expression for availability of a non-flow process. **(06 Marks"**

c. One kg of air at pressure PI and temperature 900K is mixed with one kg of air at the same pressure but at 500K. Determine the loss in availability if the atmospheric temperature is 300K. **(07 Marks)**

OR

8 a. Explain P-T diagram for water. **(06 Marks)**

b. Explain the method of determining the dryness fraction of the given sample of stream using throttling calorimeter with a neat sketch. **(07 Marks)**

c. Determine the enthalpy and internal energy of 2kg of steam at a pressure of 15 bar and 0.85 dryness. Also determine the heat supplied at constant pressure if the final condition of the steam is 70°C of superheat. Take Cp_s (superheated) = 2.25 kJ/kg. **(07 Marks)**

Module-5

9 a. Define the following terms: Mass fraction, Mole fraction, Specific humidity, Dry Bulb Temperature, Dew Point Temperature. **(05 Marks)**

b. Derive and expression for molecular weight and gas constant of a mixture of ideal gases in terms of mass fractions. **(06 Marks)**

c. A vessel of 0.2m^3 capacity contains 2kg of CO, and 1.5kg of **N2** at 300K. Determine: i) Pressure in the vessel ii) Mole fraction of each constituent iii) R and M of the mixture. **(09 Marks)**

OR

10 a. Explain the reasons for deviations of Van-der Waal's equation from ideal gas equation. **(06 Marks)**

b. Explain the following:

i) Law of corresponding states
ii) Compressibility factor
iii) Gibbos-Dalton's law. **(06 Marks)**

c. A container of 3m^3 capacity contains 10kg of CO2 at 27°C. Estimate the pressure exerted by CO2 by using:

i) Perfect gas equation
ii) Van-der Waal's equation
iii) Beattie Bridgeman equation. **(08 Marks)**