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10NT53

Fifth Semester B.E. Degree Examination, May 2017
Basic Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What is thermodynamics? Distinguish microscopic and macroscopic approaches in the study. **(06 Marks)**

b. Define and explain the following :
   i) Thermodynamic equilibrium
   ii) Mechanical equilibrium
   iii) Diathermic wall and thermal equilibrium
   iv) Chemical equilibrium. **(10 Marks)**

c. A tank contains mixture of 20kg of Nitrogen and 20kg of carbon monoxide. The total tank volume is $20m^3$. Determine the density and specific volume of the mixture. **(04 Marks)**

2 a. With a neat diagram, derive an expression for work done in each case of the following :
   i) Isochoric process
   ii) Isobaric process
   iii) Isothermal process
   iv) Polytrophic process. **(10 Marks)**

b. List the similarities between heat and work. **(04 Marks)**

c. A ballon of flexible material is to be filled with from a strong bottle unit. It has a volume $0.7m^3$. The atmospheric pressure is 1.013 bar. Determine the work done by the system comprising the air initially in the bottle given that the ballon is light and required no stretching. **(06 Marks)**

3 a. Derive an expression for first law of thermodynamics to control volume. **(08 Marks)**

b. Write the steady flow energy equation for an open system and explain terms involved in it and simplify SFEE for the following systems i) Air compressor ii) Nozzle. **(06 Marks)**

c. When the state of a system changes from state 1 to state 3 along the path 1-2-3 as shown in the diagram, 80kJ of heat flows into the system and the system does 30kJ of work. (i) how much heat flows into the system along the path 1-4-3 if work done by the system is 10kJ (ii) when the state of the system is returned from state 3 to state 1 along the curved path, the work done on the system is 20kJ. Does the system absorb or liberate heat? Find its magnitude. (iii) If $U_1 = 0$ and $U_4 = 40kJ$, find the heat absorbed in the process 1-4 and 4-3 respectively. **(06 Marks)**

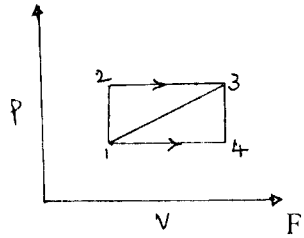

Fig Q3(c)

4 a. Describe the devices converting heat into work and work to heat in a i) Thermodynamic cycle ii) Mechanical cycle. **(10 Marks)**

b. Explain in a brief about Carnot cycle and Carnot principle. Describe the various factors that make a process irreversible, reversible heat engines. **(10 Marks)**

PART – B

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

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

c. Write a note on available energy and unavailable energy. **(06 Marks)**

6 a. i) Write a note on sub-cooled liquid and saturated liquid.

ii) Explain about saturated vapour and supersaturated vapour states of pure substance with water as example. **(10 Marks)**

b. Explain in detail the representation of various processes on T-S and H-S diagrams. **(10 Marks)**

7 a. i) Explain how specific heats of ideal gases are related to gas constant.

ii) What is the difference between perfect and semi-perfect ideal gases?

iii) Write a brief note on universal and particular gas constants. **(10 Marks)**

b. Explain briefly about evaluation of heat, work, change in internal energy, enthalpy and entropy in i) reversible hyperbolic process ii) Reversible polytropic process. **(10 Marks)**

8 a. i) State Dalton's law of additive pressures. Derive the expression for partial pressure of an individual constituent in a mixture of ideal gas.

ii) State Amagat's law of additive volumes. Derive the expression for partial volume of an individual constituent in a mixture of ideal gas. **(10 Marks)**

b. i) What are real gases? Explain briefly about compressibility factor and compressibility chart.

ii) Explain Vander Waal's equation of state and Vander Wall's constant in terms of critical properties. **(10 Marks)**

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