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10NT53

Fifth Semester B.E. Degree Examination, Dec.2016/Jan.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. Define and explain thermodynamic equilibrium, mechanical equilibrium, diathermic wall and thermal equilibrium, and chemical equilibrium. (08 Marks)
 b. Distinguish between the following with an example for each:
 i) Intensive and extensive property;
 ii) State point and path and
 iii) Quasi-static and actual process. (12 Marks)

- 2 a. List the similarities between heat and work. (04 Marks)
 b. A ballon of flexible material is to be filled with air from a strong bottle unit. It has a volume of 0.7m^3 . The atmospheric pressure is 1.013 bar. Determine the workdone by the system comprising the air initially in the bottle given that the ballon is light and required no stretching. (06 Marks)
 c. With a neat p-v diagram, derive an expression for workdone in each case of the following:
 i) Isochoric process and ii) Isothermal process. (10 Marks)

- 3 a. Derive an expression for first law of thermodynamics to control volume. (08 Marks)
 b. In a conference hall comfortable temperature conditions are maintained in winter by circulating hot water through piping system. The water enters the piping system at 3 bar pressure and 50°C temperature (enthalpy = 240 kJ/kg) and leaves at 2.5 bar pressure and 30°C temperature (enthalpy = 195 kJ/kg). The exit from the piping system is 15m above the entry. If 30 MJ/hr of heat needs to be supplied to the hall, make calculation for the quantity of water circulated through the pipe per minute. Assume that there are no pumps in the system and the change in kinetic energy is negligible. (06 Marks)
 c. Prove that energy is a property of system. (06 Marks)

- 4 a. Explain briefly about Carnot cycle and Carnot principle. Describe the various factors that make a process irreversible, reversible heat engine. (10 Marks)
 b. Describe the devices converting heat to work and work to heat in a i) Thermodynamic cycle and ii) Mechanical cycle. (10 Marks)

PART – B

- 5 a. Write a short note on available and unavailable energy. (06 Marks)
 b. State and prove Clausius inequality. (08 Marks)
 c. Explain principle of increase of entropy. (06 Marks)

- 6 a. Explain in detail the representation of various processes on T-S and H-S diagrams. (10 Marks)
 b. Brief about sub-cooled liquid and saturated liquid. (04 Marks)
 c. Explain about saturated vapour and super heated vapour state of pure substance with water as example. (06 Marks)

Important Note : I. On completing your answers compulsorily draw diagonal cross lines on the remaining blank page.
 II. Any involving of doubtful questions, appeal to evaluator and/or equations written eg, $42+8=50$, will be treated as malpractice.

- 7 a. Explain about:
- i) How specific heats of ideal gases are related to gas constant;
 - ii) The difference between perfect and semi perfect ideal gas and
 - iii) 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 and ii) reversible polytropic process. (10 Marks)
- 8 a. What is real gas? Explain briefly about compressibility factor and compressibility chart. (10 Marks)
- b. State Dalton's law of additive pressure and Amagat's law of additive volume. Derive the expression for partial volume of an individual constituent in a mixture of ideal gas. (10 Marks)

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