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10ME/AU33

**Third Semester B.E. Degree Examination, Dec.2017/Jan.2018**  
**Basic Thermodynamics**

Time: 3 hrs.

Max. Marks:100

**Note: 1. Answer any FIVE full questions, selecting at least TWO questions from each part.**

**2. Use of steam tables, gas tables, charts etc are permitted.**

**PART – A**

- 1
  - a. Distinguish between the followings with example:
    - i) Macroscopic and microscopic view point.
    - ii) Thermodynamic system and control volume.
    - iii) Extensive and intensive property.
    - iv) Thermal equilibrium and thermodynamic equilibrium.
    - v) Quasi static and spontaneous process. (10 Marks)
  - b. State Zeroth law of thermodynamics and explain the working of constant volume gas thermometer. (05 Marks)
  - c. The e.m.f. in a thermocouple with test junction at  $t^{\circ}\text{C}$  on the gen thermometer scale and reference junction at ice point is given by  $E = 0.2t - 5 \times 10^{-4}t^2$ , mV. The milli voltmeter is calibrated at ice point and steam points. What will this thermometer read in a place where gen thermometer reads  $50^{\circ}\text{C}$ ? (05 Marks)
- 2
  - a. State and explain the thermodynamic work with an example. (06 Marks)
  - b. Determine the work transfer for the following cases:
    - i) Electrical work
    - ii) Shaft work
    - iii) Flow work
    - iv) Stretching a wire and
    - v) Changing the area of a surface film. (05 Marks)
  - c. What are the similarities and dissimilarities between work transfer and heat transfer? (05 Marks)
  - d. When the valve of an evacuated bottle is opened, atmospheric air rushes into it. If the atmospheric pressure is 101.325 kPa, and  $0.6 \text{ m}^3$  of air enters into the bottle. Calculate the work done by the air. (04 Marks)
- 3
  - a. With the help of Joules experiment, explain the first law of thermodynamics for a closed system. Also state its limitation. (07 Marks)
  - b. Show that energy is a property of the system. (05 Marks)
  - c. Write down the energy equation for flow processes and reduce the same for the followings with significance:
    - i) Steady flow energy equation
    - ii) Nozzle
    - iii) Throttling device
    - iv) Compressor
    - v) Filling of an evacuated tank. (08 Marks)

- 4 a. State Kelvin-Planck and Clausius statement of second law of thermodynamics and show that former is equivalent to later. (08 Marks)
- b. What are the causes of irreversibility? Explain how it makes a process irreversible (any one). (07 Marks)
- c. Which is the more effective way to increase the efficiency of a Carnot engine: to increase  $T_1$ , keeping  $T_2$  constant or to decrease  $T_2$ , keeping  $T_1$  constant? (05 Marks)

**PART – B**

- 5 a. State and derive the inequality of Clausius. (07 Marks)
- b. Explain the principle of entropy. (05 Marks)
- c. Three identical finite bodies of constant heat capacity are at temperatures 300, 300 and 100K. If no heat and work are supplied from out-side, what is the highest temperature to which any one of the bodies can be raised by the operation of heat engines or refrigerators. (08 Marks)
- 6 a. Explain phase equilibrium diagram of water with aid of p-v and p-T diagram. Why does fusion line have negative slope? (09 Marks)
- b. Explain the construction of T-S diagram for a pure substance i.e. 1 kg of ice at  $-5^\circ\text{C}$  to steam at  $150^\circ\text{C}$ . (06 Marks)
- c. Explain any one method of determination of dryness fraction of steam. (05 Marks)
- 7 a. Show that for an ideal gas the internal energy depends only on its temperature. (08 Marks)
- b. Write down the first and second  $T_{ds}$  equation, and derive the expression for the difference in heat capacities,  $c_p$  and  $c_v$ . What does the expression signify? (12 Marks)
- 8 a. Write down the Vander Waals equation of state. How it differs from ideal gas equation of state? Explain. (06 Marks)
- b. With aid of compressibility chart for nitrogen, explain how it deviates from ideal gas equation. (06 Marks)
- c. A mixture of ideal gas contains of 3kg of nitrogen, and 5kg of carbon dioxide at a pressure of 300kPa and a temperature of  $20^\circ\text{C}$ . Find:
- Mole fraction of each constituent.
  - The equivalent molecular weight of the mixture.
  - The equivalent gas constant of the mixture, and
  - The partial pressure of mixture.
- (08 Marks)

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