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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 atleast 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°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°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 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-Plank 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°C to steam at 150°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°C. Find:

i) Mole fraction of each constituent.
ii) The equivalent molecular weight of the mixture.
iii) The equivalent gas constant of the mixture, and
iv) The partial pressure of mixture. **(08 Marks)**

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