Ds Varun

22/11/23 (M)

(85)

NATIONAL INSTITUTE OF TECHNOLOGY HAMIRPUR
DEPARTMENT OF MECHANICAL ENFINEERING
(End-Semester Examination)

Subject: Engineering Thermodynamics (ME-212) **Class:** 2nd year ME **MM:** 50
Duration: 90 min **Date:** 22/11/2023 (G2 and G4) **Exam Time:** 9:30 AM to 12:30 PM

Note: Attempt all questions. Use of steam table is allowed. Assume suitable data if missing. All question carries equal marks.

1. A rigid tank of 1 m^3 volume contains dry saturated steam at 0.2 MPa. Due to poor insulation, there is heat transfer to the surroundings and the pressure drops to 0.1 MPa after sometime. Make calculations for the final condition of the steam and the amount of heat transferred. (8)

2. The following data pertains to a compression ignition engine working on air standard Diesel cycle: Cylinder dia (bore) = 15 cm, Stroke length = 25 cm, clearance volume = 400 cm^3. Calculate the air standard efficiency of the engine if fuel injection takes place at constant pressure for 5% of the stroke. How this efficiency value will be affected If the fuel supply continues upto 8% of the stroke. (8)

3. A system consisting of 1 kg of an ideal gas at 6 bar pressure and 0.01 m3 volume executes a cyclic process comprising the following three distinct operations: (8)

a. Reversible expansion to 0.05 m3 volume and 2 bar pressure, presuming pressure to be a linear function of volume ($P = a + b\times V$).

b. Reversible cooling at constant pressure.

c. Reversible hyperbolic compression according to law PV = const.

This brings the gas back to the initial conditions. Sketch the cycle on P-V diagram. Calculate the work done in each process stating whether it is done on or by the system and evaluate the net cyclic work and heat transfer.

4. A mixture of perfect gases at 300 K has the following composition by volume, N_2 = 60%; O_2 = 15%; and CH_4 = 25%. If the partial pressure of CH_4 is 0.5 bar, make calculations for the following parameters of the mixtures. (8)

a. Partial pressures of N_2, O_2.

b. Mass proportion of mixtures.

c. Gas constant and volume per mole of mixtures.

OR

Derive Maxwell Relations and also obtain Clapeyrons equation.

A fluid at a pressure of 3 bar and with specific volume of 0.18 m^3/kg is contained in a cylinder behind piston. The fluid expands reversibly to a pressure of 0.6 bar according to the law $P = C/V^2$ re c is a constant. Calculate the work done by the fluid on the piston. (8)

a short note on the following (Attempt any four) (10)

a. Corollaries of Carnot Theorem

b. Exergy

c. Mean effective pressure

d. Compressibility factor

e. Concept of continuum

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