3E1413

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B.Tech. IIIrd Semester (Main/Back) Examination, Feb. - 2011

Common to Mech., P & I, Auto. & IEM Engg.

Engineering Thermodynamics

Time : 3 Hours **Maximum Marks : 80**

Min. Passing Marks : 24

Instructions to Candidates:

*Attempt overall **five** questions, selecting **one** question from **each** unit. Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly.*

Use of following supporting material is permitted during examination.

(Mentioned in form No.205)

1. Steam Table

2. Mollier chart

Unit - I

1. a) Explain briefly Zeroth Law of Thermodynamics.

b) Explain with a neat diagram PVT surface.

c) A fluid at a pressure of 3 bar and with specific volume of 0.18m^3/kg, contained in a cylinder behind a piston expands reversibly by a pressure of 0.6 bar according to a law, $p=\frac{C}{v^2}$, where C is a constant. Calculate the work done by the fluid on the piston. **(4+6+6=16)**

OR

2. a) Draw and explain a Pressure-Temperature diagram of pure substance.

b) A pressure cooker contains 1.5 kg of saturated steam at 5 bar. Find the quantity of heat which must be rejected so as to reduce the quality to 60% dry. Determine the pressure and temperature of the steam at the new state. **(8+8=16)**

Unit - II

3. a) State the First Law of Thermodynamics and prove that for a non-flow process, it leads to the energy equation $Q = \Delta U + W$.

   b) Write down general energy equation for steady flow systems and simplify when applied for following system (with sketches) :

      i) Steam Nozzle

      ii) Water Turbine

      iii) Gas Turbine **(8+8=16)**

OR

4. Derive expression for entropy changes for a closed system.

   a) General case for change of entropy of gas.

   b) Polytropic processes. **(8+8=16)**

Unit - III

5. 8 kg of air at 650K and S-S bar pressure is enclosed in a closed system. If the atmosphere temperature and pressure are 300K and 1bar respectively. Determine :

   a) The availability if the system goes through the ideal work producing process.

   b) The availability and effectiveness if the air is cooled at constant pressure to atmospheric temperature without bringing it to complete dead state.

   Take $C_v = 0.718$ $KJ/Kg\,K$, $C_p = 1.005$ $KJ/Kg\,K$. **(16)**

OR

6. Derive the following relations :

   a) $$\left(\frac{\partial h}{\partial p}\right)_T = v - T\left(\frac{\partial v}{\partial T}\right)_P = -C_P\left(\frac{\partial T}{\partial p}\right)_h \qquad \text{(i)}$$

   b) $$\left(\frac{\partial u}{\partial v}\right)_T = T\left(\frac{\partial p}{\partial T}\right)_v - p \qquad \text{(ii)}$$

   with the aid of equation (ii) show that

   $$\left(\frac{\partial u}{\partial p}\right)_T = -T\left(\frac{\partial u}{\partial T}\right)_P - p\left(\frac{\partial v}{\partial p}\right)_T$$

   The quantity $C_p\left(\frac{\partial T}{\partial P}\right)_h$ is known as Joule-Thomson cooling effect Show that this cooling effect for a gas obeying the equation of state $(v-b) = \frac{RT}{P} - \frac{C}{T^2}$ is equal to $\left(\frac{3C}{T^2}\right) - b$ **(16)**

Unit - IV

7. An engine with 200 mm cylinder diameter and 300 mm stroke works on theoratical Diesel cycle. The initial pressure and temperature of air used are 1 bar and 27°C. The cut off is 8% of the stroke. Determine :

   i) Pressures and Temperatures at all salient points.

   ii) Theoritical air standard efficiency

   iii) Mean effective pressure

   iv) Power of the engine if the working cycles per minute are 380.

   Assume that compression ratio is 15 and working fluid is air. Consider all conditions to be ideal. **(16)**

OR

8. a) Compare the relative advantages and disadvantages of four stroke and 2 stroke cycle engines.

   b) Compare petrol and diesel engine. **(8+8=16)**

Unit - V

9. In a single-heater regenerative cycle the steam enters the turbine at 30 bar 400°C and the exhaust pressure is 0.10 bar. The feed water heater is a direct contact type which operates at 5 bar. Find :

   a) The efficiency and steam rate of cycle.

   b) The increase in mean effective temperature of heat addition, efficiency and steam rate as compared to the Rankine cycle (without regeneration)

   The pump work may be neglected. **(16)**

OR

10. Describe a simple vapour compression cycle giving clearly its flow diagram. Explain it on Pressure-Entholpy chart also. **(16)**
