PVP 14

Code: ME3T2

II B.Tech - I Semester – Regular/Supplementary Examinations November 2018

BASIC THERMODYNAMICS
(MECHANICAL ENGINEERING)

Duration: 3 hours Max. Marks: 70

DATA BOOKS ARE ALLOWED

PART – A

Answer ***all*** the questions. All questions carry equal marks

11x 2 = 22 M

1. a) Differentiate between closed and open thermodynamic systems. Give examples.
   b) Define process and cycle. What is a quasi equilibrium process?
   c) What is meant by state and property of a substance? Classify thermodynamic properties.
   d) Show triple point of water on P-T diagram.
   e) Write the processes involved in dual cycle.
   f) What are the classical statements given by Kelvin-Planck and Clausius for second law of Thermodynamics?
   g) Define Gibb’s and Helmholtz’s functions.
   h) Distinguish between thermal efficiency and coefficient of performance.

i) If 250 kJ/s of heat is transferred from atmosphere at 7^0C to the room at 25^0C by a heat pump working on reversed Carnot cycle, what is the power required?

j) What is dryness fraction of a pure substance? Name the devices for measuring dryness fraction of steam.

k) Draw the p-v diagrams of Sterling and Ericsson cycles indicating the salient points.

PART – B

Answer any ***THREE*** questions. All questions carry equal marks. 3 x 16 = 48 M

2. a) To a closed system 150 KJ of work is supplied. If the initial volume is 0.6 m^3 and the pressure of the system changes as p=8 - 4V where p is in bar and V is in m^3, determine the final volume and pressure of the system. 8 M

b) Air contained in a cylinder comprises the system. The cycle is completed as follows: 8 M

(i) Piston does 85 kJ of work on air during its compression stroke while 40 kJ of heat is rejected to the surroundings which is mainly water in the cylinder jackets.

(ii) On the expansion stroke, air does 115 kJ of work on the piston. Determine the quantity of heat added to the system in expansion stroke. Draw a suitable p-V diagram representing the cycle.

3. a) Derive S.F.E.E stating the assumptions first. 8 M

b) One kg of Ethane (Perfect gas) is compressed from 1.1 bar, 27^0C according to a law: $pV^{1.3}$ = constant, until the pressure is 6.6 bar. Calculate the heat flow to or from the cylinder walls. Given: Molecular weight of Ethane = 30, C_p = 1.75 kJ/kg. 8 M

4. a) Explain entropy and disorder. Prove that entropy is a property of a system. 8 M

b) Calculate the entropy change of the universe as a result of the following processes: 8 M

(i) A copper block of 600 g mass and with heat capacity of 150 J/K at 100^0C is placed in a pond at 8^0C.

(ii) The sane block at 8^0C is dropped from a height of 100 m into the pond.

(iii) Two such blocks at 100^0C and 0^0C are joined.

5. a) Define: Internal energy, enthalpy and entropy of steam. Write the Clausius-Clapeyron equation and explain its significance. 8 M

b) Explain Dalton's law of partial pressure and Avogadro's law of additive volumes. 8 M

6. a) Derive an expression for air standard efficiency of Brayton cycle. 8 M

b) The compression ratio in an air-standard Otto cycle is 8. At the beginning of compression process, the pressure is 1 bar and the temperature is 300K. The heat transfer to the air per cycle is 1900 kJ/kg of air. Calculate: 8 M

(i) η_{Th} and (ii) M.E.P