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Reg. No. : .....

Name : .....

Third Semester B.Tech. Degree Examination, January 2015
(2008 Scheme)
08.305 : THERMODYNAMICS (MS)

Time : 3 Hours Max. Marks : 100

Instructions : *i) Answer **all** questions from Part – **A**.*

*ii) Answer **one full** question from **each** Module in Part – **B**.*

*iii) Assume **any** missing data **suitably**.*

PART – A

1. Differentiate among temperature, heat and internal energy.
2. What do you understand by flow work ? Is it different from displacement work ?
3. State and explain Law of corresponding states.
4. Enumerate the various properties of pure substances.
5. State and explain Carnot theorem.
6. Give an account on practical consideration with availability.
7. Is the third law an extension of second law ? Is it an independent law of nature ? Explain.
8. Distinguish between Helmholtz function and Gibbs function.
9. What is Joule-Thomson Coefficient ? Why is it zero for an ideal gas ?
10. State and explain Dalton's law of partial pressures. **(10×4=40 Marks)**

P.T.O.

PART – B

Module – I

11. a) Define state, property and process. Explain the concept of cyclic process. Differentiate between open and closed cycle. **10**

b) In a steam power station, steam flows steadily through a 0.2m diameter pipeline from the boiler to the turbine. At the boiler end, the steam conditions are found to be p = 4 MPa, t = 400°C, h = 3213.6 kJ/kg and v = 0.073 m^3/kg. At the turbine end the conditions are found to be p = 3.5 MPa, t = 302°C h = 3202.6 kJ/kg and v = 0.084 m^3/kg. There is a heat loss of 0.5 kJ/kg from the pipeline. Calculate the steam flow rate. **10**

12. a) Draw the phase equilibrium diagram for a pure substance in P-T coordinates and explain briefly. Why does the fusion line for water have negative stope ? **10**

b) A large insulated vessel is divided into 2 chambers, one containing 5 kg of dry saturated steam at 0.2 MPa and the other 10 kg of steam 0.8 quality at 0.5 MPa. If the partition between the chambers is removed and steam is mixed throughly and allowed to settle. Find the final pressure, steam quality and entropy change in the process. **10**

Module – II

13. a) Give the following statements of the second Law of Thermodynamics.

i) Kelvin-Plank statement ii) Clausius statement. Is the second law independent of the first law ? If so, prove it. **10**

b) A reversible heat engine operates between 2 reservoirs at temperatures of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40°C and – 20°C. The heat transfer to the heat engine is 2000 kJ and net work output of the combined Carnot refrigerator plant is 360 kJ.

i) Find the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40°C.

ii) Reconsider (1) When the efficiency of the heat engine and cop of the refrigerator are each 40% of their maximum possible. **10**

14. a) Derive the expression for irreversibility or energy loss in a process executed by i) closed system ii) a steady flow system, in a given environment. 10

b) A compressor operates at steady state takes in 1 kg/s of air at 1 bar and 25°C and compresses it to 8 bar and 160°C. Heat transfer from the compressor to its surroundings occurs at a rate of 100 kW.

i) Find the power input in kW.

ii) Evaluate the second law efficiency for the compressor. Neglect KE and PE changes. Take $T_o = 25^\circ C$ and $p_r = 1$ bar. 10

Module – III

15. a) Show that the slope of an isentrope is greater than that of an isotherm on P-V plot. How is it meaningful for estimating the work of compression ? 10

b) The Joule-Kelvin coefficient μ_j is a measure of the temperature change during a throttling process. A similar measure of the temperature change produced by an isentropic change of pressure is produced by the coefficient μ_s where,

$$\mu_s = \left(\frac{\partial T}{\partial p}\right)_s$$

Prove that $\mu_s - \mu_j = \frac{V}{Cp}$. 10

16. Prepare short notes on following :

a) Clapeyron Equation.

b) Properties of real gas mixtures.

c) Mass and Mole fraction.

d) Maxwell's Relations. (4×5=20 Marks)

(3×20=60 Marks)