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Reg. No. : ....

Name : ....

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

Time: 3 Hours Max. Marks: 100

***Instruction** : Answer **all** questions from Part – **A** and **any one full** question from **each** Module of Part – **B**.*

PART – A

1. State Zeroth law of thermodynamics and explain its significance.
2. What is flow work ? Explain.
3. What is a phase diagram ? Sketch the phase diagram for a substance (a) that expands on freezing (b) that contracts on freezing.
4. State any four equations of state other than the ideal gas equation of state.
5. Differentiate between heat pump and refrigerator.
6. Show that there is a decrease in available energy when heat is transferred through a finite temperature difference.
7. What are the causes of entropy rise ?
8. What is the deficiency in first law efficiency and how does the concept of second law efficiency overcome it ?
9. What is inversion curve ?
10. State and explain Amagat's law and Dalton's law. **(10×4=40 Marks)**

P.T.O.

PART – B

Module – I

11. a) Explain any four temperature measuring devices. 12

b) Water is being heated in a closed pan being stirred by a paddle wheel. During the process, 30 kJ of heat is transferred to the water, and 5 kJ of heat is lost to the surrounding air. The paddle wheel work amounts to 500 N-m. Determine the final energy of the system if its initial energy is 10 kJ. 8

OR

12. a) Derive the steady flow energy equation. 10

b) Air flows in a compressor at the rate of 0.7 kg/s. Air enters at 100 kPa pressure, 5 m/s velocity and 0.85 m^3/kg specific volume and leaves at 700 kPa, 3 m/s and 0.17 m^3/kg. The internal energy of the exit air is 80 kJ/kg greater than that of the inlet air. Cooling water in the compressor jackets absorb heat from the air at the rate of 60 kW. Determine the work input to the compressor and the ratio of inlet pipe diameter to exit pipe diameter. 10

Module – II

13. a) State Kelvin-Planck and Clausius statement of the second law of thermodynamics and prove their equivalence. 10

b) A reversible heat engine operates between two reservoirs at temperatures 600°C and 40°C. The engine drives a reversible refrigerator which operates between the reservoirs at temperatures 40°C and – 20°C. The heat transfer to the engine is 2 MJ and the net work output of the combined engine and refrigerator plant is 360 kJ. Find the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40°C. 10

OR

14. a) Derive an expression for the maximum work for an open system that exchanges heat only with the surroundings at constant pressure and temperature. 10

b) Two blocks of metal, each having a mass of 10 kg and a specific heat of 0.4 kJ/kg-K, are at a temperature of 40°C. A reversible refrigerator receives heat from one block and rejects heat to the other. Calculate the work required to cause a temperature difference of 100°C between the two blocks. 10

Module – III

15. a) Derive an expression for the change in internal energy and enthalpy of a pure substance undergoing an infinitesimal reversible process. 8

b) 0.5 kg of Helium and 0.5 kg of nitrogen are mixed at 20°C and a total pressure of 100 kPa. Find (i) the volume of the mixture, (ii) partial volumes of the components, (iii) partial pressures of the components, (iv) mole fractions of the components, (v) specific heats Cp and Cv of the mixture and (vi) the gas constant of the mixture.

[Cv_{He}= 3.1156 kJ/kg-K γ_{He} = 1.667

CvN_2 = 0.743 kJ/kg-K γN_2 = 1.4]. 12

OR

16. a) Prove that $Cp - Cv = \frac{TV\beta^2}{k}$. 8

b) A piston-cylinder device contains a mixture of 0.5 kg of H_2 and 1.6 kg of N_2 at 100 kPa and 300 k. Heat is now transferred to the mixture at constant pressure until volume is doubled. Determine the heat transfer and the entropy charge of the mixture. Take Cp_{H_2} = 14.307 kJ/kg-K, R_{H_2} = 4.1240 kJ/kg-K, Cp_{N_2} = 1.039 kJ/kg K and R_{N_2} = 0.2968 kJ/kg-K. 12