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Reg. No. : .....

Name : .....

Combined First and Second Semester B.Tech. Degree Examination, March 2018

(2013 Scheme)

13.107 : ENGINEERING THERMODYNAMICS (MNPSU)

Time : 3 Hours

Max. Marks : 100

***Instruction** : Use of approved steam tables and psychometric chart **permitted**.*

PART – A

Answer **all** questions. **Each** question carries **2** marks.

1. What are the types of thermodynamic systems ?

2. Define thermometry.

3. Define temperature scales.

4. State the limitations of first law of thermodynamics.

5. Define 'Dead state'.

6. What is a thermal reservoir ?

7. Define triple point of water.

8. Write the equation for Redlich-Kwong equation of state.

9. Define Kay's rule.

10. What is the use of psychrometers ?

P.T.O.

PART – B

Answer **any one full** question from **each** Module. **Each** question carries **20** marks.

Module – I

11. a) Derive the expression for work transfer and heat transfer in a polytrophic process.

b) A system undergoes cyclic process 12341. The values of Q, W and ΔU for the individual processes given below.

Process	ΔU(kJ)	Q(kJ)	W(kJ)
1–2	–50	–	30
2–3	–	40	–50
3–4	60	50	–
4–1	–	–	80

Complete the above table.

OR

12. a) Derive steady flow energy equation, stating all the assumptions. **10**

b) A turbine operates under steady flow conditions, receiving steam at the following state :

Pressure 1177 kPa, temperature 300°C, specific volume 0.218 m^3/kg, internal energy 2792.2 kJ/kg, velocity 2000 m/min, and elevation 3 m. The steam leaves the turbine at the following state :

Pressure 19.6 kPa, temperature 59.67°C, specific volume 7.7899 m^3/kg, internal energy 2456.5 kJ/kg, velocity 100 m/min, and elevation 0 m. Heat is lost to the surroundings at the rate of 1047 kJ/h. If the rate of steam flow through the turbine is 1150 kg/h, what is the power output of the turbine ? **10**

Module – II

13. a) Show that the entropy change per mole of an ideal gas is given by

$$\Delta s = C_p \ln\frac{T_2}{T_1} - R\ln\frac{P_2}{P_1} = C_v \ln\frac{T_2}{T_1} + R\ln\frac{v_2}{v_1}$$

10

b) Devise a reversible path to estimate the entropy change associated with the freezing of super cooled water. Calculate the entropy change if one kg super cooled liquid at –5°C freezes into ice at the same temperature. The specific heat capacities of ice and liquid water are 2.1 kJ/kg K and 4.2 kJ/kg K, respectively. The latent fusion of water at 0°C is 333.4 kJ/kg. **10**

OR

14. a) Prove that all reversible engines have the same efficiency when working between the same two heat reservoirs. **8**

b) 0.5 kg of air at 1 bar and 47°C is compressed in a piston-cylinder assembly to 4bar and 127°C by doing 5 kJ of work when the surrounding temperature is 27°C.

(Cp of air is 1.005 kJ/kgK, R = 0.287 kJ/kgK)

Determine : i) The entropy change of air
ii) The entropy change of the surroundings
iii) The entropy change of the universe. **12**

Module – III

15. a) Define and derive the importance of Gibbs and Helmholtz function. **10**

b) Calculate the specific volume of dry saturated steam at a pressure of 147 kPa at which the values of the temperature T and latent heat L are 110.79°C and 2223.3 kJ/kg respectively. Further, saturation temperature of steam at pressure of 157 kPa is 112.74°C. Neglect the specific volume of water. **10**

OR

16. a) Explain the generation of steam at constant pressure. Show that the various process on temperature-enthalpy diagram. **8**

b) 1 kg of steam enters the condenser under vacuum of 73.5 cm Hg with 4% moisture. The barometric pressure is 76 cm of Hg. The steam is condensed to a saturated liquid at constant pressure during steady flow. Determine
i) Heat transfer ii) Final temperature iii) Change in entropy. **12**

Module – IV

17. a) Explain Dalton laws of partial pressure. **8**

b) A vessel having 0.115 m^3 volume is filled with a mixture of 1.5 kg of CO_2 and 1 kg of N_2 at 25°C. Determine
i) The pressure of the mixture ii) R_{min}
iii) The mole fraction of each constituent iv) $M_{min.}$
Given that R_o = 8314.3 Nm/kg mol K. **12**

OR

18. a) Write a note on psychometric properties of gases. **8**

b) Outdoor air at 40°C d.b.t and 25°C w.b.t is mixed with return air at 27°C d.b.t and 20°C w.b.t. The resulting d.b.t of the mixture is 30°C. The volume of the mixture is 2m^3. Of the mixture 75% is chilled to a final state of 15°C 70% R.H. and the balance is passed around the coil. Find the state of the exit air. **12**