B.E./B.TECH. Degree Examination, December 2020

Third Semester

ME18301-Engineering Thermodynamics

(Regulation 2018)

(Use of approved steam table, Mollier diagram Psychometric Chart permitted in the examination)

Time: Three hours Maximum : 80 Marks

Answer **ALL** questions

PART A - (8 X 2 = 16 marks)

1. An imaginary device which would produce work continuously without absorbing any energy from its surroundings is called a

   1. PMM1 2. Heat engine 3. PMM2 4. Refrigerator.

2. An isentropic process is always

   1. Irreversible and adiabatic 2. Reversible and isothermal
   3. Frictionless. 4. Reversible and adiabatic

3. To which of the following are Maxwell's thermodynamics relations appliction?.

   1.Thermodymanics processes 2. Mechanical system in equilibrium
   3. Chemical system in equilibrium 4. Reversible process

4. 1 Kg of air contains ----------

   1) 0.121 Kg of Oxygen 2) 0.35 Kg of Oxygen
   3) 0.23 Kg of Oxygen 4) 0.73 Kg of Oxygen

5. Why second law of is called directional law of nature?
6. Determine whether water at 250 kPa, 0.3 m^3 is a compressed liquid, a super-heated vapor, or a mixture of saturated water-steam.
7. State the significance of Calusius Clapeyron equation.
8. Where are the DBT and t_{dp} identical?

PART B - (4 X16 = 64 marks)

09. (a) (i) Prove that internal energy as a property. **(8)**

(ii) Air at a pressure of 6 MPa and volume of 0.3 m^3 is expanded at constant pressure until the volume is doubled. It is then expanded according to the law $pV^{1.4}$= C until the volume is 0f.9 m^3 Calculate the work done in each process. **(8)**

(OR)

(b) (i) Show that the change in entropy of an irreversible process is always positive **(8)**

(ii) Air at 574 kPa and 300^0 C expands in a non-flow process to 175 kPa as per the law $pV^{1.2}$ is constant. Find work done, heat transfer and change in entropy per kg. **(8)**

10. (a) A pressure cooker contains 5 kgs of steam at 9 bar and 0.9 dryness fraction. Find the heat must be rejected to make a quality of steam 0.5 **(16)**

(OR)

(b) Steam at 20 bar and 360^0 C is expanded in a steam turbine 0.008 bar. It then enters a condenser, where it condensed to saturated liquid water. The pump feedback the water in to the boiler. **(16)**

a). Assuming ideal process, Find per kg of steam the network and cycle efficiency

b). If the turbine and pump have each 80 %efficiency, find the percentage reduction in he network and cycle efficiency.

11. (a) (i) Compare Real and Ideal gas **(8)**

(ii) Consider nitrogen gas at 145 K with specific volume of 0.0022 m^3/kg. Calculate its pressure using **(8)**

i). Redlich-Kwong equation

ii). Perfect gas equation.

Take p_c=3390kPa, and T_c= 126.2 kPa

(OR)

(b) (i) Solve the following Assuming Maxwell's Relations, prove that for any fluid **(8)**

$$ds = \frac{C_p}{T} dT + \left(\frac{\partial V}{\partial T} \right)_p dp$$

(ii) Explain and drive the Clausius Clapeyron equation. **(8)**

12. (a) The pressure and temperature of mixture of 4 kg of O_2 and 6 kg of N_2 are 4 bar and 27^0 C respectively. For the mixture determine the following. **(16)**

i). The mole fraction of each component

ii). The average molecular weight

iii). The specific gas constant

iv). The volume and density.

v). The partial pressure and density

(OR)

(b) Saturated air at 20^0 C at a rate of 70 m^3/min is mixed adiabatically with the outside air at 35^0 C and 50% RH at a rate of 30 m^3/min. Assuming that the mixing process occurs at 1 atm. Determine the specific humidity, RH, DBT and volume flow rate of mixture. **(16)**