(b) A reversible polytropic process is employed to expand a fluid from 10 bar and 200°C to 1 bar. The polytropic exponent is 1.15. Find the final specific volume, final temperature and the heat transferred, if the fluid is (a) air and (b) steam. 10

UNIT – IV

8. Explain why the specific heat of a saturated vapour may be negative. Also discuss GIBBS phase rule. 20

9. The mean effective pressure of an ideal Diesel cycle is 8 bar. If the initial pressure is 1.03 bar and the compression ratio is 12, determine the cutoff ratio and the air standard efficiency. Assume ratio of specific heats for air to be 1.4. 20

Roll No. .....

24046

B. Tech 3rd Semester (MAE) Examination – February, 2022

THERMODYNAMICS

Paper : ME-201-F

Time : Three hours] **[Maximum Marks : 100**

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt *five* questions. Question No. 1 is ***compulsory*** and ***one*** question from each of the four Units.

1. Discuss the following : 5 × 4

(a) Quasi-static process & thermal equilibrium

(b) 2nd and 3rd law of thermodynamics

(c) Vander Waal's equation of state

(d) Ericson cycle

UNIT – I

2. (a) What is the concept of continuum ? How will you define density and pressure using this concept ? 10

(b) 0.45 kg of air at 187°C expands adiabatically to three times its original volume and during the process, there is a fall in temperature of 160°c. The work done during the process is 53 kJ. Calculate C_p and C_v. 10

3. (a) What do you understand by flow work ? Is it different from displacement work ? 10

(b) A blower handles 1 kq/s of air at 277°C and consumes a power of 18 kW. The inlet and outlet velocities of the air are 100 m/s and 150 m/s, respectively. Find the exit air temperature, assuming adiabatic conditions. Take C_p of air is 1.005 kJ/kg K. 10

UNIT – II

4. (a) A solar powered heat pump receives heat from a solar collector at T_H, rejects heat to the atmosphere at T_A and pumps heat from a cold space at T_C. The three heat transfer rates are Q_H, Q_A and Q_C, respectively. Derive an expression for the minimum ratio Q_H/Q_C in terms of three temperatures. If T_H = 500 K, T_A = 400 K, T_C = 300 K, Q_C = 10 kW, what is the minimum Q_H ? If the collector captures 0.2 kW/m^2, what is the minimum collector area required ? 10

(b) Carry out availability analysis of the closed systems for the following processes : (a) constant volume process, (b) constant pressure process and (c) constant temperature process 10

5. (a) A mass of 7 kg of air in a vessel at 200 kPa and 300 K. Heat is transferred to the air from 1000 K until the temperature of air rises to 600 K. The environment is at 100 kPa and 290 K. Determine (a) the initial and final availability of air (b) The maximum useful work associated with the process. 15

(b) What do you understand by reversible and irreversible process from the point of view of entropy ? 5

UNIT – III

6. (a) Estimate the amount of heat that is required to produce 4 kg of steam at a pressure of 0.6 MPa and temperature of 250°C from water at 25°C. Assume the specific heat of superheated steam at 2.2 kJ/kg. 10

(b) State Gibbs theorem. Derive an expression for the enthalpy of gas mixtures. 10

7. (a) Draw a neat sketch of throttling calorimeter and explain how dryness fraction of steam is determined ? Explain its limitations. 10