CBCS SCHEME

USN | | | | | | | | | | |

17ME33

Third Semester B.E. Degree Examination, Aug./Sept.2020
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note : i) ***Answer any FIVE full questions, choosing ONE full question from each module.***
ii) ***Use of Thermodynamic handbook is permitted.***

Module-1

1 a. Define a Thermodynamic system. Differentiate between Open system , Closed system and Isolated system. **(06 Marks)**

b. Define Work in Thermodynamics. Derive an equation for displacement work in polytropic process. **(06 Marks)**

c. A temperature scale of certain thermometer is given by the relation $t = a\ell np + b$, where a and b are constants, P is thermometric property. If at ice point and steam point the thermometric properties are found to be 1.5 and 7.5 respectively. What will be the temperature corresponding to the thermometric property of 3.5 on Celsius scale. **(08 Marks)**

OR

2 a. Compare Heat and Work. **(06 Marks)**

b. State Zeroth Law of thermodynamics and explain its significance. **(06 Marks)**

c. The properties of a closed system change following the relation between pressure and volume as PV = 3.0, where P is in bar and V is volume m^3. Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. **(08 Marks)**

Module-2

3 a. Explain the First law of thermodynamics as referred to closed system under going cyclic process. **(06 Marks)**

b. State Kelvin Plank and Clausius statement of II law of Thermodynamics. **(06 Marks)**

c. 12 kg of a fluid per minute goes through a reversible steady flow process. The properties of fluid at the inlet are $P_1 = 1.4$ bar , $V_1 = 0.04 m^3/kg$, $C_1 = 120 m/s$ and $u_1 = 920$ kJ/kg and at the exit $P_2 = 5.6$ bar , $V_2 = 0.2 m^3/kg$, $C_2 = 180$ m/s and $u_2 = 720$ kJ/kg. During the passage the fluid rejects 60kJ/s of heat and rises through 60 meters. Determine the work done during the process. **(08 Marks)**

OR

4 a. Write down the general energy equation for steady flow system when applied for the following : i) Centrifugal water pump ii) Nozzle. **(06 Marks)**

b. Show that the Kelvin Plank statement and Clausius statement of II law of thermodynamics are equivalent. **(06 Marks)**

c. A reversible heat engine operated between two reservoirs at temperatures 700^0C and 50^0C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 50^0C and -25^0C. The heat transfer to the engine is 2500kJ and the net work output of the combined engine refrigerator plant is 400kJ. Determine the net heat transfer to the reservoir at 50^0C. **(08 Marks)**

Module-3

5 a. Mention the factors that makes a process Irreversible. **(06 Marks)**

b. Show that entropy is property and point function. **(06 Marks)**

c. Define Thermodynamic temperature scale and show that the efficiency of reversible heat engine does not depend on the working fluid. **(08 Marks)**

OR

6 a. State and prove Clausius Inequality. **(08 Marks)**

b. Calculate the change in entropy of 1kg of air expanding polytropically in a cylinder behind a piston from 7 bar and 600^0C to 1.05bar. The index of expansion is 1.25. **(06 Marks)**

c. One kg of ice at -5^0C is exposed to the atmosphere which is at 20^0C. The ice melts and comes into thermal equilibrium with the atmosphere. Determine the entropy increase of the universe. Take specific heat of ice as 2.093 kJ/kg K, Latent heat of fusion of ice is 333.3 kJ/kg and specific heat of water is 4.187kJ/kg K. **(06 Marks)**

Module-4

7 a. Define : i) Critical point ii) Triple point. **(04 Marks)**

b. With a neat sketch, explain the working of a throttling calori meter. **(08 Marks)**

c. The following observations were taken with a separating and a throttling calorimeter arranged in series : Water separated = 2kg.
Steam discharged from the throttling calorimeter = 20.5kg.
Temperature of steam after throttling = 110^0C.
Initial pressure = 12 bar.
Pressure after throttling = 1 bar.
Estimate the Quality of steam. **(08 Marks)**

OR

8 a. Define i) Available energy ii) Unavailable energy iii) II Law efficiency. **(06 Marks)**

b. With the help of P – T and P – V diagrams, explain the different regions for a pure substance. **(06 Marks)**

c. 1 kg of air undergoes a polytropic compression from 1 bar 290K to 6 bar and 400K. If the temperature and pressure of the surroundings are 290K and 1 bar respectively, determine the irreversibility and the effectiveness. **(08 Marks)**

Module-5

9 a. Define i) Dalton Law of partial pressure ii) Amagat's Law of additive volumes. **(04 Marks)**

b. Derive an expression for Gas Constant (R) and Molecular Weight (M) of an Ideal gas mixture. **(08 Marks)**

c. The pressure and temperature of mixture of 4kg of O_2 and 6kg of N_2 are 4 bar and 27^0C respectively. For the mixture, determine the mole fraction of each component, specific gas constant and average molecular weight. **(08 Marks)**

OR

10 a. Define i) Dry bulb temperature ii) Wet bulb temperature iii) Relative humidity. **(06 Marks)**

b. Write a short note on Vander Waals equation. **(06 Marks)**

c. Determine the pressure of air at 205^0C having a specific volume of 0.00315 m^3/kg by means of i) Ideal gas equation ii) Vander Waals equation. **(08 Marks)**

* * * * *