CBCS SCHEME

USN 1AY17AU417

15AU33

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020

Engineering Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. Use of thermodynamics data hand book is permitted.

Module-1

1 a. Distinguish between : i) Diabatic and adiabatic walls ii) Point function and path functions. **(08 Marks)**

b. A temperature scale used to measure a fluid temperature is calibrated by using the relation $t = a \ln x + b$, where a and b are constants and x is the thermodynamic property of the fluid. It was observed that at ice and steam point x takes the value of 1.5 and 7.5 respectively. Determine to the corresponding thermometric property of 3.5, what will be the fluid temperature. **(08 Marks)**

OR

2 a. Define work and heat from thermodynamic view point. Write any two similarities and dissimilarities between them. **(08 Marks)**

b. Consider the compression of a liquid inside a cylinder. Let the compression process be quasi-static as well as isothermal. The path of such a process may be given as $\ln(V/V_0) = -A(P-P_0)$ where A, V_0 and P_0 are positive constants. Derive an expression for the total amount of work required. **(08 Marks)**

Module-2

3 a. Starting from first law equation for a closed system undergoing a non-cyclic process, derive the equation for an open system undergoing steady flow, steady state situation (SFEE). List all the assumptions made. **(08 Marks)**

b. Derive clausius inequality and hence prove that entropy is a property. **(08 Marks)**

OR

4 a. An air compressor with water jacket compresses 2920 lpm of air of specific volume $V_1 = 0.7 m^3/kg$. The enthalpy of air is increased by 105kJ/kg. Transfer of heat to cooling water and surrounding is at 190 kJ/min. Assuming steady flow and neglecting changes in ke and pe, find the power required to drive the compressor. **(08 Marks)**

b. In a certain reversible process, the rate of heat transfer to the system per unit temperature rise is constant and equal to 2 kJ/°C. If the system temperature changes from 27°C to 127°C, what is the increase in entropy of the system? In a second process, between the same temperature limits if the temperature rise is accomplished by stirring action half great as in the above process, what is the increase in entropy? **(08 Marks)**

Module-3

5 a. Define the following terms : i) A : F ratio ii) Theoretical and excess air. (04 Marks)

b. Calculate the air fuel ratio for burning of propane (C_3H_8) with 130 percent theoretical air. (08 Marks)

c. Define : i) air standard efficiency ii) compression ratio. (04 Marks)

OR

6 a. An air standard Otto cycle has a compression ratio of 8. The temperature and pressure at the beginning of compression are 300K and 102KPa respectively. If the maximum cycle temperature is 1900 K, determine : i) heat supplied/kg of air ii) net work done iii) thermal efficiency of the cycle, assuming $\gamma = 1.4$ for air, $C_p = 1.005$ kJ/kg K. (08 Marks)

b. In a trial run of a 4 cylinder, 4 stroke petrol engine of 90 mm bore and 100mm stroke the net dynamometer load was 1400N at a radius of 460mm, when the speed was 2200 rpm. At the same speed and throttle opening the engine required 4 kN to motor it with the ignition switched off. Calculate the mechanical efficiency and mean effective pressure. During a 3 minute run at this speed and power, the engine used 2.4 kg of petrol of CV 42980 kJ/kg and 100 kg of water with a temperature rise of 40°C. Draw up a heat balance sheet in kJ/min. (08 Marks)

Module-4

7 a. With a schematic diagram explain the working of a vapour absorption refrigeration system, labeling all major components. (08 Marks)

b. In an ideal vapour compression refrigerator of 15kW cooling capacity, the saturated vapour leaves the evaporator with an enthalpy of 178kJ/kg. The enthalpies at the exit of the compressor and condenser are respectively 210 kJ/kg and 65 kJ/kg. Show the refrigeration cycle on T-S and p-h diagrams and calculate : i) COP ii) Refrigerant flow rate iii) power input to the compressor. (08 Marks)

OR

8 a. Define : i) specific humidity ii) dew point temperature iii) degree of saturation iv) relative humidity. (08 Marks)

b. If mixture of dry air and water vapour is at 16°C. Find : i) saturation pressure of water vapour at 22°C ii) specific humidity iii) relative humidity. (08 Marks)

Module-5

9 a. Explain multi stage compression and mention its advantages with reference to i) Volumetric efficiency ii) Balancing iii) Work input iv) Overall size. (08 Marks)

b. Determine the minimum work required to compress 1 kg of air at 1 bar, 27°C to 9 bar absolute in 2 stages. The law of compression $PV^{1.35}$ = constant and inter-cooling is complete. If the air was compressed in on stage between the same pressure limits what is the percentage saving in work by compressing in two stages? Take R = 0.287 kJ/kg K. (08 Marks)

OR

10 a. Classify gas turbines and explain the working of an open cycle gas turbine. (08 Marks)

b. A gas turbine power plant operates on ideal Brayton cycle. The minimum and the maximum cycle temperatures are respectively 300K and 800K. Find the value of optimum pressure ratio for maximum specific output and the cycle efficiency for this condition. Take $\gamma = 1.4$. (08 Marks)

* * * * *