CBCS SCHEME

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Third Semester B.E. Degree Examination, Dec.2023/Jan.2024
Engineering Thermodynamics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Distinguish between:
(i) Macroscopic and microscopic approaches
(ii) Intensive and extensive properties
(iii) Open and closed system
(iv) Thermal and mechanical equilibrium **(10 Marks)**

b. The temperature 'T' on a thermometric scale is defined as $T = a\ell nk + b$, where a and b are constants, the values of k are found to be 1.83 and 6.78 at 0°C and 100°C respectively. Calculate the temperature for a value of k = 2.42. **(10 Marks)**

OR

2 a. With the help of p-v diagram, show the polytropic work expression as $w_{1-2} = \frac{p_1v_1 - p_2v_2}{n-1}$. **(10 Marks)**

b. A certain amount of gas is compressed from 1 bar and 0.1 m^3 to 5 bar and 0.03 m^3 the process is according to the law $PV^n = K$. Determine the magnitude and direction of work transfer. **(10 Marks)**

Module-2

3 a. State the First law of Thermodynamics for a cyclic process and with a neat sketch, explain Joule's experiment. **(10 Marks)**

b. A system undergoes a non-flow frictionless process, following pressure-volume relation as $P = \frac{S}{V} + 1.5$, where P is in bar and V is in m^3. During the process, the volume changes from 0.15 m^3 to 0.05 m^3 and system rejects 45 kJ of heat. Determine :
(i) Change in internal energy (ii) Change in enthalpy **(10 Marks)**

OR

4 a. State two statements of second law of thermodynamics. Further prove that violation of Kelvin Plank statement also violates Clausius statement. **(10 Marks)**

b. With a simple block diagram represent PMM of II kinds, why it is not possible, also show $(COP)_{HP} = 1 + (COP)_{Refrigerator}$. **(10 Marks)**

Module-3

5 a. Prove that entropy is a property. **(10 Marks)**

b. A 5 kg copper block at a temperature of 200°C dropped into an insulated tank containing 100 kg oil at a temperature of 30°C. Find the increase in entropy of the universe due to this process when copper block and the oil reach thermal equilibrium. Assume that the specific heat of copper and oil are respectively 0.4 kJ/kg-K and 2.1 kJ/kg-K. **(10 Marks)**

OR

6 a. Sketch and explain P-T diagram of water. **(10 Marks)**

b. Find the dryness fraction, specific volume and internal energy of steam at 7 bar and enthalpy is 2550 kJ/kg. **(10 Marks)**

Module-4

7 a. With a neat sketch, explain the working of vapour absorption refrigeration system. **(10 Marks)**

b. Sketch and explain the working of vapour compression refrigeration system. **(10 Marks)**

OR

8 a. Define the following terms:
(i) Dew point temperature
(ii) Relative humidity
(iii) Specific humidity
(iv) Degree of saturation
(v) Wet bulb temperature **(10 Marks)**

b. A mixture of dry air and water vapour is at a temperature of 16°C. Find:
(i) Partial pressure of water vapour and dry air
(ii) Specific humidity
(iii) Relative humidity
(iv) Mass of water vapour and dry air. **(10 Marks)**

Module-5

9 a. With the help of P-V and T-S diagrams, derive an expression for air standard efficiency of a diesel cycle. **(10 Marks)**

b. Minimum pressure and temperature in an Otto cycle are 100 kPa and 27°C. The amount of heat added to the air per cycle is 1500 kJ/kg. Determine:
(i) The pressure and temperatures at all points
(ii) Thermal efficiency of the cycle for a compression ratio of 8:1.
For air CV = 0.72 kJ/kg.K; $\gamma = 1.4$. **(10 Marks)**

OR

10 a. In detail, explain Morse test for a multi-cylinder engine. **(10 Marks)**

b. The following observations were made during one hour test on a single cylinder 4-stroke oil engine:
Bore = 300 mm, stroke = 450 mm,
mass of fuel used = 8.8 kg, calorific value = 41,800 kJ/kg,
average speed = 200 rpm, mean effective pressure = 5.8 bar,
brake load = 1860 N, mass of cooling water circulated = 650 kg,
Temperature rise = 22°C, diameter of brake drum = 1.22 m.
Calculate:
(i) Mechanical efficiency
(ii) Brake thermal efficiency
(iii) Draw heat balance sheet **(10 Marks)**

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