R13

Code: 13A03302

B.Tech II Year I Semester (R13) Regular & Supplementary Examinations December 2015

THERMODYNAMICS

(Mechanical Engineering)

(Use of Thermodynamics tables, Mollier diagram, Psychrometric chart and Refrigeration tables are permitted in the examination hall)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) State the differences between a closed system and an open system.
(b) Explain what you understand by the term thermodynamic equilibrium.
(c) List out the types of irreversibility.
(d) State the Kelvin Planck statement of the second law of thermodynamics.
(e) What is a pure substance?
(f) Write down the steady flow energy equation for a nozzle and diffuser.
(g) Write down the equation of state of an ideal gas.
(h) List out the applications of Clausius – Clapeyron equation.
(i) Write down the formula for air standard efficiency of an Otto cycle.
(j) Define an ideal gas.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 A piston and cylinder machine contains a fluid system which passes through a complete cycle of four processes. During a cycle, the sum of all heat transfers is -170 kJ. The system completes 100 cycles per minute. Complete the following table showing the method for each item and compute the net rate of work output in kW.

Process	Q (kJ/min	W (kJ/min)	ΔE (kJ/min)
a – b	0	2,170	-
b – c	21,000	0	-
c – d	-2,100	-	-36,600
d – a	-	-	-

OR

3 A certain water heater operates under steady flow conditions receiving 4.2 kg/sec of water at 75℃, enthalpy 313.93 kJ/kg. The water is heated by mixing with steam which is supplied to the heater at temperature 100.2℃ and enthalpy 2676 kJ/kg. The mixture leaves the heater as liquid water at temperature 100℃ and enthalpy 419 kJ/kg. How much steam must be supplied to the heat per hour?

UNIT – II

4 A reversible heat engine operates between two reservoirs at temperature of 600℃ and 40℃. The engine drives a reversible refrigerator which operates between reservoirs at temperature of 40℃ and -20℃. The heat transfer to the heat engine is 2000 kJ and the net work output of the combined engine refrigerator plant is 360 kJ. Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40℃.

OR

5 Deduce the expression for availability in a steady flow process.

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UNIT – III

6 A vessel of volume 0.04 m^3 contains a mixture of saturated water and statured steam at a temperature of 250℃. The mass of the liquid present is 9 kg. Find the pressure, the mass, the specific volume, the enthalpy, the entropy and the internal energy.

OR

7 The following data were obtained with a separating and throttling calorimeter:
Pressure in pipeline = 1.5 MPa
Condition after throttling = 0.1 MPa, 110℃
During 5 min moisture collected in the separator = 0.150 liter at 70℃
Steam condensed after throttling during 5 min = 3.2 kg
Find the quality of steam in the pipeline.

UNIT – IV

8 A mass of air is initially at 260℃ and 700 kPa and occupies 0.028 m^3. The air is expanded at constant pressure to 0.084 m^3. A polytropic process with n = 1.50 is then carried out, followed by a constant temperature process which completes a cycle. All the processes are reversible.
(a) Sketch the cycle in the p-v and Ts planes.
(b) Find the heat received and heat rejected in the cycle.
(c) Find the efficiency of the cycle.

OR

9 Prove that $\mu_s - \mu_j = \frac{V}{C_p}$.

UNIT – V

10 A certain gas C_P = 1.968 and C_V = 1.507 kJ/kgK. Find the molecular weight and the gas constant. A constant volume chamber of 0.3 m^3 capacity contains 2 kg of this gas at 5℃. Heat is transferred to the gas until the temperature is 100℃. Find the work done, the heat transferred and the changes in internal energy, enthalpy and entropy.

OR

11 Derive the Air standard efficiency of a diesel cycle.

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