

Total No. of Questions : 8]

SEAT No. :

PA-1279

[Total No. of Pages : 3

[5925] 304

S.E. (Mechanical/Automobile & Mechanical/Mechanical-S.W)

ENGINEERING THERMODYNAMICS (2019 Pattern)

(Semester-II) (202043)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Solve four questions; Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6 and Q.7 or Q.8.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Use of steam tables, Mollier charts and scientific table is allowed.
- 4) Assume suitable data wherever necessary.
- 5) Figures to the right indicate full marks.

- Q1) a) Explain the terms Available energy, Unavailable energy and Availability. [6]
- b) What do you mean by 'Clausius inequality'? [6]
- c) Steam expands adiabatically in a turbine from 20 bar, 400°C to 4 bar, 250°C. calculate: [5]
- i) The isentropic efficiency of the process;
  - ii) The loss of availability of the system assuming an atmospheric temperature of 20°C. The changes in K.E. and P.E. may be neglected.

OR

- Q2) a) Prove that entropy is a property of a system [6]
- b) 300 kJ/s of heat is supplied at a constant fixed temperature of 290°C to a heat engine. The heat rejection takes place at 8.5°C. The following results were obtained: [6]
- i) 215 kJ/s are rejected.
  - ii) 150 kJ/s are rejected.
  - iii) 75 kJ/s are rejected.

Classify which of the result report a reversible cycle or irreversible cycle or impossible results.

- c) 3 kg of gas ( $c_v=0.81$  kJ/kg K) initially at 2.5 bar and 400 K receives 600 kJ of heat from an infinite source at 1200 K. If the surrounding temperature is 290 K, find the loss in available energy due to above heat transfer. [5]

P.T.O.

- Q3) a)** A vessel having a capacity of  $0.05 \text{ m}^3$  contains a mixture of saturated water and saturated steam at a temperature of  $245^\circ\text{C}$ . The mass of the liquid present is  $10 \text{ kg}$ . [6]

Find the following:

- i) The pressure
  - ii) The mass
  - iii) The specific volume
  - iv) The specific enthalpy
  - v) The specific entropy and
  - vi) The specific internal energy
- b) Draw p-v, T-s and h-s diagram for Rankine cycle. [6]
- c) Explain the Limitations of Carnot Cycle. [5]

OR

- Q4) a)** p-V-T (Pressure-Volume-Temperature) surface for pure substance. [6]
- b) A vessel having a volume of  $0.6 \text{ m}^3$  contains  $3.0 \text{ kg}$  of liquid water and water vapour mixture in equilibrium at a pressure of  $0.5 \text{ MPa}$ . Calculate. [6]
- i) Mass and volume of liquid;
  - ii) Mass and volume of vapour.
- c) Compare Rankine Cycle and Carnot Cycle. [5]

- Q5) a)** Explain the Bomb calorimeter with a neat sketch. [6]
- b) The percentage composition of sample of liquid fuel by weight is, C=84.8 per cent, and  $\text{H}_2=15.2$  per cent. Calculate [6]
- i) The weight of air needed for the combustion of  $1 \text{ kg}$  of fuel;
  - ii) The volumetric composition of the products of combustion if 15 per cent excess air is supplied.
- c) Following results were obtained when a sample of gas was tested by Junker's gas calorimeter: Gas burnt in the calorimeter= $0.80 \text{ m}^3$ , Pressure of gas supply= $5.2 \text{ cm}$  of water, Barometer= $75.5 \text{ cm}$  of Hg. Temperature of gas= $13^\circ\text{C}$ , Weight of water heated by gas= $28 \text{ kg}$ , Temperature of water at inlet= $10^\circ\text{C}$ , Temperature of water at outlet= $23.5^\circ\text{C}$ , Steam condensed= $0.06 \text{ kg}$ . Determine the higher and lower calorific values per  $\text{m}^3$  of the gas at a temperature of  $15^\circ\text{C}$  and barometric pressure of  $76 \text{ cm}$  of Hg. [6]

OR

- Q6)** a) The gravimetric analysis of a sample of coal is given as 82% C, 10% H<sub>2</sub> and 8% ash. Calculate: The stoichiometric A/F ratio and the analysis of the products by volume. [6]
- b) The chemical formula for alcohol is C<sub>2</sub>H<sub>6</sub>O. Calculate the stoichiometric air/fuel ratio by mass and the percentage composition of the products of combustion per kg of C<sub>2</sub>H<sub>6</sub>O. [6]
- c) Explain adiabatic flame temperature? [6]
- Q7)** a) Give the classification of boilers. [6]
- b) Derive an expression for the diameter of chimney. [6]
- c) Draw a neat sketch of Cochran boiler. Name different parts of the boiler. [6]

OR

- Q8)** a) Differentiate fire tube boilers and water tube boilers. [6]
- b) Draw a neat sketch of fusible plug and explain its construction and working. [6]
- c) Give the classification of draught. List out Merits of Natural Draught. [6]