Total No. of Questions—**8**] [Total No. of Printed Pages—**4**

Seat No.	

[5252]-113

S.E. (Mechanical/Automobile/Sandwich) (First Semester)

EXAMINATION, 2017

THERMODYNAMICS

(2012 PATTERN)

Time : Two Hours **Maximum Marks : 50**

N.B. **:—** (*i*) Solve 4 questions, Q. **1** *or* Q. **2**, Q. **3** *or* Q. **4**, Q. **5** *or* Q. **6**, Q. **7** *or* Q. **8**.

(*ii*) Answer for the *four* questions should be written in same answer book attach supplement if required.

(*iii*) Neat diagrams should be drawn wherever necessary.

(*iv*) Use of steam tables, Mollier charts, scientific calculator is allowed.

(*v*) Use of pocket calculator & different gas charts as applicable is allowed

(*vi*) Assume suitable data if necessary.

(*vii*) Figures to the right indicate full marks.

1. (*a*) State the limitations of first law of Thermodynamics and state Kelvin Planck and Clausius statement of the second law of thermodynamics. Draw Heat Engine, Heat Pump and Refrigerator principle and formula for calculating its performance. [6]

(*b*) The volume of a given container is 40 m^3 containing Air. The initial pressure and temperature of the Air is 1 bar, 25 deg. C. Mass of Air inside the container is released till the cylinder

P.T.O.

pressure and temperature becomes 0.4 bar, 5 deg. C. Estimate the mass of Air in kg discharged to the atmosphere. R = 287 J/kg K for Air. [6]

Or

2. (*a*) Derive the relation for heat transfer and work transfer for isothermal process. [6]

(*b*) In a steam plant, 1 kg of water per second flows steadily to the boiler. The enthalpy and velocity of water entering the boiler are 800 kJ/kg and 5 m/s. The water receives 2200 kJ/kg of heat in the boiler at constant pressure. The steam after passing through the turbine comes out with a velocity of 50 m/s, and its enthalpy is 2520 kJ/kg. The inlet is 4 m above the turbine exit. Assuming the heat losses from the boiler and the turbine to the surroundings are 20 kJ/s, calculate the power developed by the turbine. Consider the boiler and turbine as single system. [6]

3. (*a*) Derive the relation for efficiency for Brayton gas power cycle. [6]

(*b*) A vessel having a volume of 0.6 m^3 contains 3.0 kg of liquid water and water vapour mixture in equilibrium at a pressure of 0.5 MPa. [6]

Calculate :

(*i*) Mass and volume of liquid

(*ii*) Mass and volume of vapour.

Or

4. (*a*) Discuss the principle of separating Calorimeter with a neat diagram. [6]

(*b*) An inventor claims that a new heat cycle will develop 0.4 kW for a heat addition of 32.5 kJ/min. The temperature of heat source is 1990 K and that of the sink is 850 K. Is his claim true. [6]

5. (*a*) Discuss the Boiler plant layout indicating location of various accessories and water, air and flue gas circuit. [6]

(*b*) 5400 kg of steam is produced per hour at a pressure of 750 kPa in a boiler when feed water is at 41.5 deg. C. The dryness fraction of the steam is 0.98. The amount of the coal burnt per hour is 670 kg with CV of 31000 kJ/kg. Determine the boiler efficiency and equivalent evaporation. [7]

Or

6. (*a*) Show in tabular form boiler heat balance sheet and the formulas involved for estimating each component. [6]

(*b*) A boiler is equipped with a chimney of 24 m height. The ambient temperature is 25 deg. The temperature of flue gases passing through the chimney is 300 deg. C. If the air flow through the combustion chamber is 20 kg/kg of fuel burned, find :

(*i*) The theoretical draught in cm of water column and

(*ii*) The velocity of the flue gases passing through the chimney if 50% of the head is lost in friction. [7]

7. (*a*) Derive the relation for minimum amount of air required per kg of fuel for complete combustion. [6]

(*b*) The percentage composition by mass of a solid fuel used in a boiler is given below : [7]

C = 90%, H_2 = 3.5%, O_2 = 3%, N_2 = 1%, S = 1% remaining is ash. Find the mass of air required for complete combustion and mass analysis of dry products of combustion.

Or

8. (*a*) Discuss the construction and working of Boys gas Calorimeter with neat sketch and thus derive the formula for HCV in Boys gas calorimeter. [6]

(*b*) The following observations were made during the test for finding the lower CV of a solid fuel with the help of Bomb Calorimeter : [7]

Mass of fuel = 0.78 gm, Mass of fuse wire = 0.02 gm, CV of fuse wire = 6500 kJ/kg, Mass of Calorimeter water = 1.88 kg, Water equivalent of Calorimeter = 0.37 kg. Observed temperature rise = 3 deg. C. Mass of condensate collected 0.2808 gm.