Total No. of Questions—**8**] [Total No. of Printed Pages—**5**

Seat No.	

[5057]-212

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

EXAMINATION, 2016

THERMODYNAMICS

(2012 PATTERN)

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

N.B. **:—** (*i*) Answer Q. No. **1** or Q. No. **2**, Q. No. **3** or Q. No. **4**, Q. No. **5** or Q. No. **6**, Q. No. **7** or Q. No. **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 and different gas charts as applicable is allowed.

(*vi*) Assume suitable data, if necessary.

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

1. (*a*) Discuss the steady flow energy equation derived from first law of Thermodynamics and apply SFEE to the following devices and write down the equation : [6]

(*i*) Boiler/Evaporator

(*ii*) Condenser

(*iii*) Throttling device

P.T.O.

(*iv*) Pump/Compressor

(*v*) Turbine

(*vi*) Nozzles/Diffusers.

(*b*) One kg of a fluid is confined to a constant volume tank. Initial pressure and volume are 4 bar and 0.21 m^3 respectively. When heat energy of 82 kJ is supplied to the system the final temperature of the gas becomes 127 deg. C. Determine :

(*i*) Work done

(*ii*) Change in internal energy

(*iii*) Change in entropy

(*iv*) Specific heat at constant volume.

Assume R = 300 J/kg K.

Or

2. (*a*) Discuss the three conditions of Clausius inequality for any system undergoing a process and thus discuss the increase in the entropy of the universe principle. [6]

(*b*) A small turbine runs an aircraft refrigeration system. Air enters the turbine at 4 bar and 40 deg. C and velocity of 40 m/s. At the exit air is at 1 bar, 2.5 deg. C and having velocity of 200 m/s. If the work output of the turbine is 52 kJ/kg of the air, calculate the heat transferred per kg of air. Assume Cp for air 1.005 kJ/kg K. [6]

3. (*a*) Derive the expression of COP for air standard reversed Brayton Cycle. [6]

(*b*) Determine the amount of heat that should be supplied to 2 kg of water at 25 deg. C to convert into steam at 5 bar and 0.9 dry. [6]

Or

4. (*a*) Explain with neat labeled T-s diagram Rankine Vapor power cycle and derive the equation for efficiency of Rankine cycle. [6]

(*b*) An Otto Cycle engine has a bore of 80 mm and stroke of 85 mm. The clearance volume of the engine is 0.06 litre. The actual thermal efficiency of the engine is 22%. Determine :

(*i*) Compression ratio

(*ii*) Air standard efficiency

(*iii*) Relative efficiency of the engine.

Assume, gamma = 1.4.

5. (*a*) Discuss the boiler heat balance sheet showing all possible heat energy utilization components. [6]

(*b*) The following readings were recorded during a trial of six hours duration :

(*i*) Steam pressure 12 bar

(*ii*) Mass of steam generated 40,000 kg.

(*iii*) Mean dryness fraction 0.85

(*iv*) Mean feed water temperature 30 deg. C

(*v*) Coal used 4,000 kg

(*vi*) CV of coal 33400 kJ/kg.

Calculate :

(1) Equivalent evaporation from and at 100 deg. C

(2) Efficiency of the boiler.

Or

6. (*a*) Discuss the concept of Natural draught with neat labeled sketch as used in Chimney of boiler plants and write down the formula for chimney draught in mm of water column. [6]

(*b*) Calculate the height of chimney required to produce a draught equivalent to 1.7 cm of water of the flue gas temperature is 270 deg. C and ambient temperature is 22 deg. C and minimum amount of air per kg of fuel is 17 kg. [7]

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

(*b*) Gasoline (C_8H_{18}) reacts with pure oxygen gas to form products that include only CO_2 and H_2O. Determine the mass of each product per kg of fuel supplied of the reaction. [7]

Or

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

(*b*) Determine the air fuel ratio and the theoretical amount of air required by mass for complete combustion of a fuel containing 85% carbon, 8% hydrogen, 3% oxygen, 1% sulphur and remaining is ash, if 40% of excess air is used ? [7]