Total No. of Questions—12]   [Total No. of Printed Pages—4+1

Seat No.	

[4957]-111

S.E. (Automobile/Mechanical Engineering)
(First Semester) EXAMINATION, 2016
APPLIED THERMODYNAMICS
(2008 PATTERN)

Time : Three Hours   **Maximum Marks : 100**

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** from Section I and Q. No. **7** *or* Q. No. **8**, Q. No. **9** *or* Q. **10**, Q. **11** *or* Q. No, **12** from Section II.

(*ii*)   Answers to the two Sections should be written in separate answer-books.

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

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

(*v*)   Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

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

SECTION I
Unit I

1.   (*a*)   Explain Clausius statement and Kelvin-Planck statement with diagram.   [8]

(*b*)   Define the 'entropy'. Also explain how it is a measure of irreversibility.   [8]

P.T.O.

Or

2. (*a*) Show the equivalence of two statements of second law of thermodynamics. [8]

(*b*) Write a short note on perpetual motion machine of first and second kind (PMM-I and PMM-II). [8]

Unit II

3. (*a*) Explain the concept of available and unavailable energy. When does the system become dead ? [8]

(*b*) One kg of air is compressed polytropically from 1 bar pressure and temperature of 300 K to a pressure of 6.8 bar and temperature of 370 K. Determine the irreversibility if the sink temperature is 293 K. Assume R = 0.287 kJ/kg K, C_p = 1.004 kJ/kgK and C_v = 0.716 kJ/kgK. [10]

Or

4. (*a*) Write final equations for heat transfer, work done internal energy and change in entropy for isothermal process. [8]

(*b*) 1 kg of air at a pressure of 8 bar and a temperature of 100°C undergoes a reversible polytropic process following the law pv1.2 = constant. If the final pressure is 1.8 bar determine work done and the heat transfer. Assume R = 0.287 kJ/kg K and γ = 1.4. [10]

Unit III

5. (*a*) Write a short note on dryness fraction. How is it determined ? [8]

(*b*) Write short notes on Reheat and Regenerative cycle. [8]

Or

6. (*a*) What are the reasons due to which Carnot cycle is not used as an ideal cycle for vapour power plant ? [8]

(*b*) Explain the following terms :

(*i*) Wet steam

(*ii*) Dry steam

(*iii*) Superheated steam

(*iv*) Dryness fraction of a steam. [8]

SECTION II
Unit IV

7. (*a*) Describe proximate analysis and ultimate analysis and their relevance. [8]

(*b*) The percentage composition of sample of liquid fuel by weight is C = 84.8 per cent, and H_2 = 15.2 per cent. Calculate the weight of air needed for the combustion of 1 kg of fuel. [8]

Or

8. (*a*) How calorific value of solid fuels is measured ? [8]

(*b*) A coal sample gave the following analysis by weight, carbon 85 per cent, hydrogen 6 per cent, oxygen 6 per cent, the remainder being incombustible. Determine minimum weight of air required per kg of coal for chemically correct composition. [8]

Unit V

9. (*a*) What are the advantages of multi-staging in reciprocating air compressor ? [8]

(b) A single stage single acting reciprocating air compressor has air entering at 1 bar, 20°C and compression occurs following polytropic process with index 1.2 up to the delivery pressure of 12 bar. The compressor runs at the speed of 240 r.p.m. and has L/D ratio of 1.8. The compressor has mechanical efficiency of 0.88. Determine the isothermal efficiency and cylinder dimensions. Also find out the rating of drive required to run the compressor which admits 1 m³ of air per minute. [8]

Or

10. *(a)* Write short notes on :

(i) Free air delivery

(ii) Theoretical and actual indicator diagram. [8]

(b) During an experiment on reciprocating air compressor the following observations are being taken :

Barometer reading = 75.6 cm Hg,

Manometer reading across orifice = 13 cm Hg.

Atmospheric temperature = 25°C

Diameter of orifice = 15 mm.

Coefficient of discharge across the orifice = 0.65

Take density of Hg = 0.0135951 kg/cm³

Determine the volume of free air handled by compressor in m³/min. [8]

Unit VI

11. (*a*) Write down the use and location of the following boiler devices :

(*i*) Superheater

(*ii*) Fusible plug

(*iii*) Water level indicator

(*iv*) Economizer. [8]

(*b*) Determine the actual evaporation per kg of coal and the equivalent evaporation if during boiler trial of one hour duration following observations are made :

Feed water supply temperature : 27°C

Mean steam generation pressure : 10 bar

Dryness fraction of steam generated : 0.95

Feed water supplied : 2500 kg/hr

Coal burnt : 275 kg/hr

Mass of water in boiler after trial = 300 kg less than that at commencement of trial. [10]

Or

12. (*a*) Write notes on :

(*i*) Equivalent evaporation

(*ii*) Boiler efficiency. [8]

(*b*) A boiler is being tested for 24 hours and during this trial steam at average pressure of 10 bar, dry saturated is produced from 15 ton of water consuming 1.5 ton of coal. Composition of coal has 3% moisture and 4% ash. Feed water is added at 35°C. Determine :

(*i*) the boiler efficiency

(*ii*) the equivalent evaporation per kg of dry coal and

(*iii*) the equivalent evaporation per kg of combustible present in coal. [10]