Total No. of Questions—**12**] [Total No. of Printed Pages—**7**

Seat No.	

[4757]-112

S.E. (Automobile/Mechanical Engineering)

(First Semester) EXAMINATION, 2015

APPLIED THERMODYNAMICS

(2008 PATTERN)

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

N.B. :— (*i*) Assume suitable data, if necessary.

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

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

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

(*v*) Answer *three* questions from Section I and *three* questions from Section II.

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

Section I

Unit I

1. (*a*) Show that coefficient of performance of heat pump and refrigerator can be related as : $(COP)_{Ref} = (COP)_{Heat\ Pump} - 1$. [8]

(*b*) Write Clausius statement and Kelvin-Planck statement. [8]

P.T.O.

Or

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

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

Unit II

3. (*a*) Describe the Helmholtz function. [8]

(*b*) Two tanks A and B contain 1 kg of air at 1 bar, 50°C and 3 bar, 50°C when atmosphere is at 1 bar, 15°C. Identify the tank in which stored energy is more. Also find the availability of air in each tank. [10]

Or

4. (*a*) Define availability. Obtain an expression for availability of closed system. [8]

(*b*) Cylindrical vessel of 1 m diameter and 4 m length has hydrogen gas at pressure of 100 kPa and 27°C. Determine the amount of heat to be supplied so as to increase gas pressure to 125 kPa. [10]

For hydrogen take C_p = 14.307 kJ/kg.K, C_v = 10.183 kJ/kg K.

Unit III

5. (*a*) What is pure substance ? Draw and explain p-V diagram for water. [8]

(*b*) Write short notes on the following : [8]

(*i*) Sensible heating

(*ii*) Latent heating

(*iii*) Critical point

(*iv*) Triple point

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 : [8]

(*i*) Wet steam

(*ii*) Dry steam

(*iii*) Superheated steam

(*iv*) Dryness fraction of a steam

Section II

Unit IV

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

(*b*) Coal having the following composition by mass is burnt with theoretically correct amount of air : [8]

86% C, 6% H, 5% O, 2% N, 1% S. Determine the air-fuel ratio.

Or

8. (*a*) Explain Orsat gas apparatus method of gas analysis in brief. [8]

(*b*) Determine the higher and lower calorific values of coal for which the following observations are made in bomb calorimeter : [8]

Mass of coal sample = 1 gm

Mass of water in bomb calorimeter = 2.5 kg

Initial temperature of water = 20°C

Maximum recorded temperature of water = 22.6°C

Water equivalent of apparatus = 750 gm

Cooling correction = + 0.018°C

Consider coal to have 5% H_2 in it.

Unit V

9. (*a*) Draw P-v and T-s diagram for Isothermal, polytrophic and isentropic works and compare the three works. Write down equation of the work for three cases. [8]

(*b*) During an experiment on reciprocating air compressor the following observations are being taken : [8]

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/cm^3

Determine the volume of free air handled by compressor in m^3/min.

Or

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

(*b*) A single cylinder air compressor delivers 9 kg of air per minute. The air is compressed from 1 bar and 27 deg. C to 7 bar. The compression process follows the law $PV^{1.25} = C$. Find work done and brake power required if mechanical efficiency is 85%. [8]

Unit VI

11. (*a*) Write a note on boiler mountings and accessories. [8]

(*b*) Steam is generated in a boiler at 30 bar 300°C at the rate of 11 kg/s with feed water entering economizer at 100°C. During one hour test 5000 kg fuel is used in boiler. Calorific value of fuel is 35000 kJ/kg. For the feed water being supplied to boiler to be at 27°C determine : [10]

(*i*) the equivalent evaporation per kg of fuel

(*ii*) the boiler efficiency

(*iii*) the percentage of fuel energy utilized in economizer

Or

12. (*a*) Write notes on : [8]

(*i*) Equivalent evaporation

(*ii*) Boiler efficiency.

(*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 : [10]

(*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.