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

Seat No.	

[4657]-12

S.E. (Mechanical/Automobile) (First Semester) EXAMINATION, 2014

APPLIED THERMODYNAMICS

(2008 PATTERN)

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

N.B. **:—** (*i*) Answer any *three* questions from Section I and any *three* questions from Section II.

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

(*iii*) Neat sketches 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*) Discuss the limitations of first law of thermodynamics. [6]

(*b*) Explain Kelvin Planck and Clausius statements of second law of thermodynamics. [10]

P.T.O.

Or

2. (*a*) Prove equivalence of Kelvin-Planck and Clausius statements with neat diagrams. [10]

(*b*) Write a note on reversibility and give reasons. [6]

Unit II

3. (*a*) Explain the following : [6]

(*i*) Available and unavailable energy.

(*ii*) High grade and low grade energy.

(*iii*) Dead state.

(*b*) Explain availability of heat source at constant temperature and variable temperature. [10]

Or

4. (*a*) For an Ideal gas prove that heat is transferred in a polytropic process is given by : [10]

$$Q = \frac{\gamma - n}{\gamma - 1} \times \text{W.D. in a Polytropic Process}$$

(*b*) In a piston and cylinder arrangement the pressure varies inversely proportional to the square of volume during a process. The initial pressure in the cylinder is 20 bar and the initial volume is 0.1 m^3. The final pressure after expansion is 200 kPa. Estimate the work done. [6]

Unit III

5. (*a*) With a neat sketch explain Separating Calorimeter. [8]

(*b*) Explain the following terms : [10]

(*i*) Pure Substance

(*ii*) Steam formation and phase change

(*iii*) Satuaration temperature

(*iv*) Dyrness fraction

(*v*) Degree of superheat.

Or

6. (*a*) Prove that Rankine cycle efficiency is given by : [8]

$$\eta_R = \frac{h_2 - h_3}{h_2 - h_4}$$ with usual notations.

i.e. h_2 = specific enthalpy of steam formed

h_3 = specific enthalpy of steam entering condenser

h_4 = specific enthalpy after condensation

(*b*) Steam at 20 bar and 360ºC expands in a steam turbine to 0.08 bar. It is then condensed in a condenser to saturated water. The pump feeds back the water to the boiler. Assume ideal Rankine cycle and determine : [10]

(*i*) Net work done/kg of steam

(*ii*) η_R.

SECTION II

Unit IV

7. (*a*) Explain Bomb Calorimeter to determine the CV of solids fuels. [8]

(*b*) Give the classification of fuels and also explain HCV and LCV. [8]

Or

8. (*a*) Explain with neat sketch Boy's gas calorimeter. [8]

(*b*) Explain the following : [8]

(*i*) Stoichiometric mixture

(*ii*) Excess air

(*iii*) Actual and stoichiometric air fuel ratio

(*iv*) Rich mixture, Weak mixture and Mixture strength.

Unit V

9. (*a*) Prove that work input for the reciprocating air compressor, if compression follows $PV^n = c$, is given by :

Work input or IP $= \frac{n}{n-1} P_1V_1 \left\{ \left(\frac{p_2}{p_1} \right)^{\frac{n-1}{n}} - 1 \right\}$ with usual notations. [8]

(*b*) A single-stage, single-acting RAC delivers air at 6 bar. The suction temperature is 25°C, and suction pressure is 1 bar, volume of air entering the compressor is 3 m^3/min. Index of compressor is 1.2. Calculate :

(*i*) Isothermal efficiency

(*ii*) Power required to drive the compressor, neglecting clearance volume. [8]

Or

10. (*a*) Explain for reciprocating air compressor : [6]

(*i*) Clearance volume

(*ii*) Isothermal efficiency

(*iii*) FAD.

(*b*) Discuss the following : [4]

(*i*) Need of multistaging

(*ii*) Intercooling and aftercooling.

(*c*) Explain with a neat sketch Roots blower. [6]

Unit VI

11. (*a*) Give the classification of steam generator. [8]

(*b*) Explain with neat sketches the following mountings : [10]

(*i*) Fusible plug

(*ii*) Water level indicator.

Or

12. (*a*) Explain : [6]

(*i*) Boiler thermal efficiency;

(*ii*) Equivalent of evaporation from and at 100°C.

(*b*) During a boiler trial the following data was obtained :

Duration of trials = 8 hrs

Pressure of steam = 14 bar

Dryness fraction = 0.973

Feed water evaporated = 26700 kg

Temperature of inlet water = 50°C

Fuel used = 4260 kg

Calorific value of fuel = 28900 kJ/kg

Air used/kg of fuel = 17 kg

Temperature of flue gases = 344°C

Boiler room temperature = 21°C

Cp of flue gases = 1.1 kJ/kg-K

Determine :

(1) Boiler efficiency

(2) Equivalent of evaporation

(3) Heat lost to flue gases in kJ/kg of coal and in percentage. [12]