

Total No. of Questions—8]

[Total No. of Printed Pages—5

Seat No.	
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[5252]-513

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

EXAMINATION, 2017

THERMODYNAMICS

(2015 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, Psychrometric chart, 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.

(v) Figures to the right indicate full marks.

1. (a) Define and explain on P-v diagram : [6]

(i) Thermodynamics state

(ii) Thermodynamics Process and

(iii) Thermodynamics Cycle.

(b) Experimental data of Specific heat capacity measurement of air at constant Pressure are as follows : [6]

1. Mass of air = 0.05 kg

2. Air heated from 287 K to 347 K for 300 seconds using a heater with input Power-10.04 W.

3. Adiabatic index = 1.4.

P.T.O.

Determine :

1. Specific heat of air at constant pressure,
2. Characteristic gas constant of Air (R) and
3. Density of air at 273 K and 1 bar.

Or

2. (a) Draw any *three* of the following processes : [6]
- (i) Constant Pressure or Isobaric process on P-v diagram.
 - (ii) Constant Volume or Isochoric Process on P-v diagram.
 - (iii) Constant temperature or Isothermal Process on T-s diagram.
 - (iv) Reversible Adiabatic or Isentropic Process on T-s diagram.
- (b) The COP of the Carnot refrigerator is 6, when it maintains the temperature of 270 K in the evaporator. Determine the condenser temperature and Refrigerating effect if the power required to run the refrigerator is 7.5 kW. [6]
3. (a) Define and explain any *six* of the following terms with neat sketch showing piston, cylinder arrangement for air standard cycle : [6]
- (i) Clearance volume
 - (ii) Swept volume
 - (iii) Total Volume
 - (iv) TDC
 - (v) BDC
 - (vi) Compression ratio
 - (vii) Air standard efficiency.
- (b) A throttling calorimeter is used to determine the dryness fraction of the steam using steam at 10 bar. The condition of steam after throttling is 1.2 bar, 118 deg. C. Calculate the dryness fraction of the steam assuming $C_p = 2.1$ kJ/kg. [6]

Or

4. (a) State and explain different components of Rankine cycle on flow diagram and draw the Thermodynamic cycle on T-s diagram. [6]
- (b) A refrigerating system operates on reversed Carnot cycle. The higher temperature of the refrigerant in the system is 308 K and the lower temperature is 258 K. Refrigerating effect of the refrigerator is 42.2 kW.
- Determine : [6]
- (i) COP and
- (ii) heat rejected from the system.
5. (a) Give the function and location of any *three* of the following : [6]
- (i) Super heater
- (ii) Air pre heater
- (iii) Fusible plug
- (iv) Water level indicator
- (v) Spring loaded safety valve.
- (b) The following results were obtained in a boiler trial : [7]
- (i) Feed water per hour = 700 kg at 27 deg. C
- (ii) Steam produced at 8 bar and 0.97 dry.
- (iii) Coal used = 100 kg/hr having CV of coal = 25000 kJ/kg
- (iv) Ash and Unburnt coal collected = 7.5 kg/hr having CV = 2000 kJ/kg
- (v) Mass of flue gases produced per kg of fuel burnt = 17.3 kg
- (vi) Flue gas temperature = 327 deg. C

(vii) Room temperature = 16 deg. C

(viii) Specific heat of flue gases = 1.025 kJ/kg K

Draw the energy balance on minute basis.

Or

6. (a) Derive the formula for : [6]

(i) Equivalent evaporation and

(ii) Boiler efficiency.

(b) How much air is used per kg of coal burnt in a boiler having chimney of 32.3 m height to create the draught of 19 mm of water column when the temperature of the flue gases in the chimney is 370 deg. C and the temperature of the boiler house is 29.5 deg. C. [7]

7. (a) Define Human comfort condition and discuss the factors affecting human comfort. [6]

(b) Atmospheric air at 30 deg. C DBT and 18 deg. C WBT is cooled to 20 deg. C DBT without changing its moisture content. Find : [7]

(i) Initial enthalpy and specific humidity of air,

(ii) Final relative humidity of air and WBT,

(iii) Sensible heat removed per kg of air.

Or

8. (a) Define the following terms : [6]

(i) DBT

(ii) Specific humidity

(iii) WBT

(iv) Relative humidity

(v) Degree of saturation

(vi) DPT.

- (b) Moist air enters a steam heating coil at 10 deg. C, 50% RH which is heated sensibly and leaves the coil at 30 deg. C. The mass flow rate of the moist air is 50 kg/s.

Find :

- (i) Sensible heat gained by air,
- (ii) Mass flow rate of the steam in the coil if the steam enters the coil as saturated steam and the condensate leaves the coil at 85 deg. C at atmospheric pressure. [7]