

May 2017

Total No. of Questions—8]

[Total No. of Printed Pages—5

Seat No.	
-------------	--

[5152]-513

S.E. (I Sem.) (Mechanical/Automobile/Sandwich)

EXAMINATION, 2017

THERMODYNAMICS

(2015 PATTERN)

Time : Two Hours

Maximum Marks : 50

- N.B. :—**
- (i) Solve 4 questions 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, 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.
 - (vii) Figures to the right indicate full marks.

1. (a) Define a thermodynamic system and surroundings. Give classification of systems with example. [6]
- (b) A fluid system, contained in a piston and cylinder machine, passes through a complete cycle of four processes. The sum of all heat transferred during a cycle is – 340 kJ. The system completes 200 cycles per min. Complete the following table

P.T.O.

showing the method for each item, and compute the net rate of work output in kW. [6]

Process	Q(kJ/min)	W(kJ/min)	ΔE (kJ/min)
1—2	0	4340	—
2—3	42000	0	—
3—4	-4200	—	-73200
4—1	—	—	—

Or

2. (a) Show that $C_p - C_v = R$. Derive the relation for heat transfer and work transfer for constant pressure process. [6]
- (b) An iron cube at a temperature of 400°C is dropped into an insulated bath containing 10 kg water at 25°C . The water finally reaches a temperature of 50°C at steady state. Given that the specific heat of water is equal to 4186 J/kg K . Find the entropy changes for the iron cube and the water. Is the process reversible ? If so why ? [6]
3. (a) What is a available energy ? Define dead state, useful work and unavailable work. [6]
- (b) An engine working on Otto cycle, air has pressure of 1 bar and temperature of 27°C . Air is compressed adiabatically with a compression ratio of 7 and then heat is added at constant volume till the temperature rises to 2000 K . Find the air standard efficiency, pressure at the end of compression and heat addition in process and the mean effective pressure of the cycle. Assume, $C_v = 0.718 \text{ kJ/kgK}$, $\gamma = 1.4$ and $R = 287 \text{ Nm/kgK}$. [6]

Or

4. (a) Discuss the principle of separating calorimeter with a neat labeled diagram. [6]
- (b) A thermal power plant works on Rankine cycle has a boiler pressure of 120 bar and condenser pressure of 5 kPa. Steam is superheated in the super heater to 400 deg. C. Find per kg of steam generated by boiler : [6]
- (i) Net work output
 - (ii) Rankine efficiency
 - (iii) Specific steam consumption.
5. (a) Give the function and location of any 3 of the following : [6]
- (i) Super heater
 - (ii) Air preheater
 - (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/kgK

Draw the energy balance on minute basis.

Or

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

- (i) Equivalent evaporation and
- (ii) Boiler efficiency.

- (b) The following readings were recorded during a boiler trial of 6 hrs duration : [7]

Mean steam pressure = 12 bar; Mass of steam generated = 40000 kg

Mean dryness fraction = 0.85; mean feed water temperature = 30°C

Coal used = 4000 kg; Calorific value of coal = 33400 kJ/kg

Calculate :

- (i) Factor of equivalent evaporation
- (ii) Heat rate of boiler in kJ/kg
- (iii) Equivalent evaporation form and at 100°C
- (iv) Efficiency of boiler.

7. (a) What are the factors affecting Human Comfort ? Discuss in detail. [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 and discuss the significance of the following : [6]
- (i) Wet Bulb temperature
 - (ii) Dew point temperature
 - (iii) Humidity ratio.
- (b) Air enters a window air conditioner at 1 atm and 30 deg C and 80% RH at a rate of 10 m³/min and leaves as saturated at 14°C. A part of moisture which condenses during the process is also removed at 14°C. Determine the heat flow rate and moisture removed from the air. Show the process on psychrometric diagram. [7]