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, Pscychrometric 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 deg. 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 kJ/kgK, γ = 1.4 and R = 287 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 = 30ºC

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 100ºC

(*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 m^3/min and leaves as saturated at 14ºC. A part of moisture which condenses during the process is also removed at 14ºC. Determine the heat flow rate and moisture removed from the air. Show the process on psychrometric diagram. [7]