

Total No. of Questions : 8]

SEAT No. :

P-9195

[Total No. Of Pages : 3

[6179]-328

**S.E. (Mechanical-Sandwich/Automobile & Mechanical)**  
**ENGINEERING THERMODYNAMICS**  
**(2019 Pattern) (Semester - III) (202043) (Theory)**

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right side indicate full marks.
- 4) Use of electronic pocket calculator, steam table is allowed.
- 5) Assume suitable data, if necessary.

Q1) a) Give the following statements of second law of thermodynamics. [7]

- i) Clausius statement
- ii) Kelvin-Plank statement

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 -340KJ. The system completes 200 cycles per minute. [10]

Complete the following table showing the method for each item and compute the net rate of work output in kW.

Process	Q KJ/min	W KJ/min	$\Delta E$ KJ/min
1-2	0	4340	?
2-3	42000	0	?
3-4	-4200	?	-73200
4-1	?	?	?

OR

P.T.O.

- Q2) a)** A system at 500 K receives 7200 KJ/min from a source at 1000 K. The temperature of atmosphere is 300 K. Assuming that the temperature of system and source remain constant during heat transfer, Determine: [8]
- The entropy produced during heat transfer
  - The decrease in available energy after heat transfer.
- b) State Boyle's law and Charle's law and derive an equation of the state for a perfect gas? [9]

- Q3) a)** Explain the following terms: (i) Saturated steam, (ii) Dry saturated steam, (iii) Wet steam, (iv) Superheated steam, (v) Dryness fraction of steam, (vi) Specific volume of steam, and (vii) Saturated water. [8]
- b) 0.025 m<sup>3</sup> of steam at 3.5 bar and dryness fraction 0.8 is converted into dry saturated steam at 11 bar. By how much are the enthalpy and internal energy changed? [10]

OR

- Q4) a)** A Rankine cycle operates between pressure of 80 bar and 0.1 bar. The maximum cycle temperature is 600°C. If the steam turbine and condensate pump efficiencies are 0.9 and 0.8 respectively. Calculate specific work and thermal efficiency? [12]

P bar	T °C	Specific Volume m <sup>3</sup> /kg		Specific Enthapy KJ/Kg			Specific Entropy KJ/KgK		
		v <sub>f</sub>	V <sub>g</sub>	h <sub>f</sub>	h <sub>fg</sub>	h <sub>g</sub>	S <sub>f</sub>	S <sub>fg</sub>	S <sub>g</sub>
0.1	45.84	0.0010103	14.68	191.9	2392.3	2584.2	0.6488	7.5006	8.1494
80	295.1	0.001385	0.0235	1317	1440.5	2757.5	3.2073	2.5351	5.7424

At 80 bar, 600°C:  $V_{sup} = 0.486 \text{ m}^3/\text{Kg}$ ;  $h_{sup} = 3642 \text{ KJ/Kg}$ ;  $S_{sup} = 7.0206 \text{ KJ/Kg K}$

- b) Explain the constructional details & working of Throttling calorimeter? [6]
- Q5) a)** How the analysis of exhaust and flue gas carried out? Explain in details with neat sketch? [6]
- b) The following is the ultimate analysis of a sample of petrol by weight: Carbon, C = 85%, Hydrogen, H<sub>2</sub> = 15% [11]
- Calculate the ratio of air to petrol consumption by weight if the volumetric analysis of dry exhaust gas is:  
CO<sub>2</sub> = 11.5%, CO = 1.2%, O<sub>2</sub> 0.9%, N<sub>2</sub> = 86%
- Also; determine the % excess air supplied?

OR

**Q6) a)** What do you mean by Higher Calorific value of fuel (HCV) and lower calorific value of fuel (LCV)? Name the apparatus used for the determination of HCV of the fuel. [6]

b) A fuel  $C_{10}H_{22}$  was burnt using an air fuel ratio of 13:1 by weight. Determine the complete gravimetric analysis of the products of combustion, assuming that the whole amount of hydrogen burns to form water vapour and there is neither any free oxygen nor any free carbon. **The carbon burns to  $CO_2$  and  $CO$ .** Air contains 77% of nitrogen and 23% of oxygen by weight. [11]

**Q7) a)** What is the function of Boiler Accessories? Explain with neat sketches any two of the accessories? [8]

b) In a boiler test 1250 Kg of coal are consumed in 24 hours. The mass of water evaporated is 13000 Kg and the mean effective pressure is 7 bar. The feed water temperature was  $40^\circ C$ , heating value of coal is 30000 KJ/Kg. The enthalpy of 1 Kg of steam at 7 bar is 2570.7 KJ. Determine: [10]

i) Equivalent Evaporation per Kg of coal;

ii) Efficiency of the Boiler.

OR

**Q8) a)** What do you mean by Boiler Draught and how are they classified. Enumerate the advantages of Mechanical Draught? [6]

The following observations were made during the trial of a boiler plant consisting of a battery of 6 Lancashire boilers and an economizer:

Calorific value of fuel/coal per Kg .....29915 KJ

Mass of feed water per Kg of dry coal .....9.1 Kg

Equivalent Evaporation from and at  $100^\circ C$  per Kg of dry coal .... 9.5 Kg

Temperature of feed water to economizer .....  $12^\circ C$

Temperature of feed water to boiler .....  $105^\circ C$

b) Air Temperature .....  $13^\circ C$  [12]

Temperature of the flue gases entering economizer .....  $370^\circ C$

Mass of flue gases entering the economizer ..... 18.2 Kg/Kg of coal

Mean specific heat of flue gases .....  $1.046 KJ/Kg^\circ C$

Determine:

i) The efficiency of the boiler alone?

ii) The efficiency of the economizer alone?

iii) The efficiency of the whole plant?

