

Total No. of Questions : 8]

SEAT No. :

**P1614**

**[6002]- 244**

[Total No. of Pages : 3

**S.E. ( Mechanical & Automobile/ Mechanical SW)**

**THERMODYNAMICS**

**(2019 Pattern) (Semester - III) (202043)**

*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)** Explain the concept of Available and Unavailable energy. When does the system become dead? [8]

b) 1 Kg of air at a pressure of 8 bar and a temperature of 100° C undergoes a reversible Polytropic process following the law  $pv^{1.2} = \text{constant}$ . If the final pressure is 1.8 bar determine the increase in entropy, work done and heat transfer of the system? [9]

OR

**Q2) a)** State Boyle's law and Charles's law and derive an equation of the state for a perfect gas? [8]

b) 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: [9]

i) The entropy produced during heat transfer.

ii) The decrease in available energy after heat transfer.

**Q3) a)** Explain the constructional details & working of Separating & Throttling calorimeter? [10]

b) 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]

OR

*P.T.O.*

- 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 Enthalpy KJ/Kg			Specific Entropy KJKg K		
		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) Find the external work done during evaporation, internal latent enthalpy and internal energy per kg of steam at a pressure of 15 bar (1,500 kPa) when the steam is [6]

- 0.9 dry, and
- dry saturated

- Q5) a)** Describe with the help of neat sketch (any one) the following calorimeters used for the determination of heating values [11]

- Bomb Calorimeter
- Junker gas calorimeter

- b) What do you mean by Stoichiometric Air Fuel ratio (A/F ratio) and explain the advantages/disadvantages of excess air supplied for the combustion? [6]

OR

- Q6) a)** What are the advantages of using Liquid fuels over Solid fuels? List out minimum six advantages with justification? [6]

- b) Percentage volumetric analysis of a sample of flue gases of a coal fired boiler gave  $\text{CO}_2 = 10.4\%$ ,  $\text{CO} = 0.2\%$ ,  $\text{O}_2 = 7.8\%$ , and  $\text{N}_2 = 81.6\%$  (by difference). Gravimetric Percentage analysis of coal was  $\text{C} = 78\%$ ,  $\text{H}_2 = 6\%$ ,  $\text{O}_2 = 3\%$  and incombustible = 13%. Estimate: [11]

- i) Weight of dry flue gases per Kg of fuel
- ii) Weight of excess air per Kg of fuel.

**Q7) a)** What is the function of Boiler Mountings? Explain with neat sketches any three of the mountings? [8]

b) A steam generator evaporates 18000 Kg/hr of steam at 12.5 bar and a quality of 0.97 from feed water at 105°C, when coal is fired at the rate of 2040 Kg/hr. If the HCV of the coal is 27400 KJ/Kg, Determine: [10]

- i) The heat rate of boiler in KJ/Hr;
- ii) The Equivalent Evaporation;
- iii) The thermal 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]

b) A steam generator delivers steam at 100 bar, 500°C (Enthalpy,  $h=3373.7$  KJ/Kg). The feed water inlet temperature is 160°C ( $h=677$  KJ/Kg). The enthalpies of saturated liquid and saturated vapour at 100 bar are 1407.65 KJ/Kg and 2724.7 KJ/Kg respectively. The steam generation rate is 100000 Kg/hr and the steam generator efficiency is 88%. Estimate: [12]

- i) The fuel burning rate in Kg/hr, if the calorific value of fuel is 21 MJ/Kg;
- ii) The percentage of total heat absorbed in the economizer, evaporator and superheater.

*Assume that only latent heat is absorbed in the Evaporator (Boiler drum) and neglect any pressure drop.*

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