Q. P. Code: 26051

(3 Hours) **[Total Marks 80]**

N. B. : (1) Question No **1** is **compulsory.**
(2) Solve any **three** questions from remaining **five** questions.
(3) Assume suitable data if required.
(4) Use of Mollier Chart, Steam table is permitted.

1. Explain any **four** of the following: - **20**
   (a) Explain Zeroth law of thermodynamics with its significance.
   (b) Explain principle of increase of entropy.
   (c) What do you mean by available energy and unavailable energy? Explain with suitable example
   (d) Explain Rankine cycle with reheat.
   (e) Explain Atkinson cycle with T-S and H-S diagrams.
   (f) Explain adiabatic flame temperature with its practical significance.

2. (a) What do you mean by steady flow process. Write equation for steady flow process for compressor and boiler. **8**
   (b) A reversible heat engine operates between 875 K and 310 K and drives a reversible refrigerator operating between 310 K and 255 K. The engine receives 2000 kJ of heat and the net work output from the arrangement equals 350 kJ. Make calculations for the cooling effect. **12**

3. (a) Explain:- **8**
      i. State
      ii. Property
      iii. Pure substance
      iv. system
   (b) A lump of steel of mass 8 kg at 1000 K is dropped in 80 kg of oil at 300K Make calculations for the entropy change of steel, the oil and the universe. Take specific heats of steel and oil as 0.5 kJ/kg K and 3.5 kJ/kg K, respectively. **8**
   (c) Show that entropy is a property of system **4**

4. (a) Water at 25^0C is to be heated to 80^0C by utilizing the heat available from a source at a steady temperature of 500^0C. If the ambient temperature is 20^0C, what would be the (i) gain in availability of the water? (ii) Effectiveness of the heating process? **8**
   (b) A steam power plant operates ideally in the basic Rankine cycle. It receives 4 Mpa steam from the boiler firing coal to liberate heat at a steady rate of 100 MW. The steam after expansion in the turbine is exhausted to a condenser that operates at 7.5 kPa. **8**
   Calculate the:-
      i. cycle efficiency
      ii. work ratio for the cycle
      iii. power output (MW) of the plant
      iv. mass flow rate of the working fluid
      v. specific steam consumption

[TURN OVER]

(c) Draw T-S and H-S diagram for steam **4**

5. (a) In an air standard Otto cycle has a compression ratio of 8, temperature and pressure at the beginning of compression are 20^0C and 1bar respectively. The constant volume Heat addition is 1800 kJ/kg. Calculate the maximum temperature and pressure of the cycle and the temperature of the end of compression process. What are the efficiency and mean effective pressure (mep) of the cycle?. **12**
Take Cv = 0718 kJ/kg K and $\gamma = 1.4$

(b) Explain flue gas analysis by Orsat apparatus. **8**

6. (a) What is cut-off ratio? How does it affect thermal efficiency of Diesel cycle? **5**

(b) Explain: (i) Enthalpy of reaction, (ii) Enthalpy of formation. **5**

(c) Define system boundary and surrounding with suitable example and figure. **5**

(d) Explain Joule's experiment. **5**

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