Q. P. Code: 26050

(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) What is PMM-I? Why it is impossible?
   (b) Explain principle of increase of entropy.
   (c) What do you mean by high grade energy and low grade energy? Explain with suitable example
   (d) Draw schematic diagram of Rankine cycle with reheat and also draw its T-S and H-S diagrams.
   (e) Explain Brayton cycle with T-S and H-S diagrams.
   (f) Explain adiabatic flame temperature with its practical significance.

2. (a) Differentiate between – **8**
   i) Microscopic and Macroscopic point of view.
   ii) Heat and Work Energy.

   (b) A heat engine operating between two reservoirs at 1000 K and 300 K is used to drive a heat pump which extracts heat from the reservoir at 300 K, at a rate twice that at which the engine rejects heat to it. If the efficiency of the engine is 40% of the maximum possible and the coefficient of performance of the heat pump is 50% of the maximum possible, make calculations for the temperature of the reservoir to which the heat pump rejects heat. Also workout the rate of heat rejection from the heat pump if the rate of supply of heat to the engine is 50 kW. **12**

3. (a) A hot iron forging (specific heat 0.5 kJ/kg K) weighs 30 kg and has a temperature of 500^0C. The forging is dropped into 200 kg oil mass (specific heat 2.5 kJ/kg K) at 25^0C for quenching. Make calculations for the entropy change of forging, entropy change of oil and entropy change of the composite system. It may be presumed that there is no loss of heat to the surroundings. **8**
   (b) Distinguish between surrounding work, useful work and reversible work. **6**
   (c) "An increase in pressure raises the boiling point of a liquid" substantiate it. **6**

4. (a) By burning a fuel, the rate of heat release is 500 kW at 1727^0C. Determine the first law and the second law efficiencies if (**i**) the energy is absorbed in a furnace at the rate of 480 kW at 727^0C, (**ii**) the energy is absorbed at the rate of 450 kW for generation of steam at 227^0C, (**iii**) energy is absorbed in a chemical process at the rate of 300 kW and 47^0C. Take T_0 = 300K. **8**

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(b) A steam power plant operates in a Rankine cycle with superheated steam. The inlet steam conditions are pressure 20bar and temperature 360^0C.The steam undergoes isentropic expansion in the turbine and exhausted to a condenser operating at 0.08bar. Determine the efficiency of the cycle. **8**

(c) Define- **4**

i. Dryness fraction
ii. Enthalpy
iii. Internal energy
iv. Entropy

5. (a) In an air standard Diesel cycle, the compression ratio is 16. At the beginning of isentropic compression, the temperature is 15^0C and the pressure is 0.1 MPa. Heat is added until the temperature at the end of constant pressure process is 1480^0C. Calculate: (i) the cut-off ratio, (ii) the heat supplied per kg of air, (iii) the cycle efficiency, and (iv) mean effective pressure. **12**

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

6. (a) Derive equation for efficiency of Otto cycle. **5**

(b) Define stoichiometric air, excess air and air fuel ratio. **5**

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

(d) Write down the SFEE on unit mass basis and apply on turbine and nozzle. **5**

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