Time: 3 hours **Marks: 80**

N.B: (1) Question No.1 is compulsory.

(2) Attempt any three from question No.2 to 6

(3) Use illustrative diagram whenever required.

1. Attempt **Any FOUR** **20**

(a) What is thermodynamics system and state its type.

(b) Define the following term related to I.C engine: - i) Bore ii) Stroke iii) Clearance volume iv) Compression Ratio

(c) What is basic difference between Fire tube and Water tube boiler?

(d) State and explain Fourier law of Heat conduction.

(e) What is film wise and drop wise condensation?

2. (a) State and explain 2^{nd} law of Thermodynamics. **06**

(b) Derive the expression for efficiency of the Brayton Cycle with all notations. **08**

(c) Explain Cochran Boiler with a neat sketch. **06**

3. (a) An engine working on Otto cycle as a volume of 0.45 m^3, pressure at 1 bar and temp 30° C at the beginning of the compression stroke. At the end of the compression stroke the pressure is 11 bar. 210 kJ of heat is added at constant volume. Calculate: i) pressure, temp and volume at silent points in the cycle. ii) Efficiency iii) mean effective pressure iv) work done in kJ/kg v) compression ratio **08**

(b) A steel pipe with 50 mm OD is covered with a 6.4 mm asbestos insulation [k = 0.166 W/ m^2 k] followed by a 25 mm layer of fiber-glass insulation [k = 0.0485 W/mk].the pipe wall temperature is 393k and the outside insulation temperature is 311 calculate the interface temperature between the asbestos and fiber-glass. **07**

(c) Define condensation and boiling. **05**

4. (a) A steel ball 55 mm in diameter and at 895 ^{0}C is placed in still atmosphere of 30 ^{0}C.Calculate the initial rate of cooling of the ball in ^{0}C/min. Take: ρ = 7800 kg/m^3, c = 2kJ/kg ^{0}C (for steel); h = 30 W/m^2 ^{0}C.Neglect internal thermal resistance. **10**

(b) **)** Write the steady flow energy equation for a single stream entering and single stream leaving a control volume and explain various terms in it. **10**

5. (a)Explain with neat sketches various boiler accessories. **10**

(b) A surface condenser consists of two hundred thin walled circular tubes (each tube is 22.5 mm in diameter and 5 m long) arranged in parallel, through which water flows. If the mass flow rate of water through the tube bank is 160 kg/s and its inlet and outlet temperature are known to be 21 ° C and 29 ° C respectively, calculate the average heat transfer coefficient associates with flow of water.

The thermo-physical properties of water at 25° C are: ρ = 996.65 kg/m^3, C_p = 4.174 kJ/kgK. k = 0.6079W/m°C and $\nu = 0.805 \times 10^{-6}$ m^2/s, P_r = 5.42

Use relation $\mathbf{N_u = 0.023^* (R_e)^{0.8} (P_r)^{0.4}}$ **10**

6. (a) Calculate the net radiant heat exchange per m^2 area for two parallel plates at temperature of 427 °C and 27 °C respectively. ε (hot plate) = 0.9 and ε (cold plate) = 0.6.If a polished aluminium shield is placed between them, find the percentage reduction in the heat transfer; ε (shield) = 0.4. **05**

(b) Derive an expression for LMTD in case of parallel flow heat exchanger. **10**

(c) Explain overall heat transfer coefficient. **05**

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