Q. P. Code: 37784

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) State the First Law of Thermodynamics and give mathematical Expression of it for a process and for cycle.

(b) Give the Comparison between Fire tube and water tube boilers.

(c) Differentiate between two and four Stroke Engine.

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

(e) State and explain the Kirchhoff's law of thermal radiation.

2. **(a)** A domestic food freezer maintains a temperature of -15 ^{0}C.The ambient air temperature is 30 ^{0}C.if heat leak into the freezer at the continuous rate of 1.75 kJ/s what is least power necessary to pump this heat out continuously ? **06**

(b) Derive an expression of efficiency of the diesel cycle. **08**

(c) Differentiate between Impulse and reaction steam turbines. **06**

3. **(a)** In air standard Otto cycles the pressure ratio during the compression is 15.Temperature of air at beginning of compression is 37 ^{0}C and maximum temperature in cycles is 1950 ^{0}C.Determine (a) Compression Ratio (b) Thermal efficiency and (c) Work done. **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 311K. Calculate the interface temperature between the asbestos and fiber-glass. **07**

(c) Explain briefly the condensation mechanism. **05**

4. **(a)** A steel ball 50 mm in diameter and at 900 ^{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 boiler various mounting. **10**

(b) Air entering at 2 bar pressure and bulk temp of 200° C is heated as it flow through a tube with a diameter of 25.4 mm and velocity of 10 m/s. Calculate heat transfer per unit length of the tube if the constant heat flux condition is maintained at the wall and the wall temp is 20° C above the air temp all along the length of the tube. How much would the bulk temp increases over 3 m length of the tube.
Take the properties if the air as: $\rho = 1.493$ kg/m^3; $\mu = 2.57 \times 10^{-5}$ N-s/m^2; $k = 0.0386$ W/m°C.
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) Explain the Mode of heat transfer **05**

(c) Derive expression for LMTD in case of counter flow heat exchanger. **10**

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