

Q.P. Code: 26026

Time: 3 Hours

Marks: 80

Note: 1. Attempt any 4 questions

2. Figures to the right indicate full marks

3. Clearly mention the assumptions made if any

4. Use of Heat Transfer Data Book and Steam tables are permitted.

- Q.1** a) Draw a neat line diagram of cooling tower showing all details. Also write different parameters required for testing of cooling tower. 10
 b) Discuss a general design methodology of heat exchanger with a flow chart representing sequence of various design activities. 10
- Q.2** a) A large condenser is designed to remove 800 MW of energy from condensing steam at 100°C. To accomplish this task, cooling water enters the condenser at 25°C and leaves at 30°C. The overall heat transfer coefficient is 2000 W/m²°C. Calculate the area required for the heat exchanger. h_{fg} at 100°C is 2257 kJ/kg. 10
 b) Discuss the different types of baffles and their effect on heat transfer. 10
- Q.3** a) Discuss different types of failures of heat exchangers and remedies. 10
 b) Discuss various fouling mechanisms and factors which influence fouling process. 10
- Q.4** a) Discuss the constructional details, advantages and disadvantages of the following heat exchangers:- 12
 i) Fixed head tubular heat exchanger
 ii) Floating head 1-2 exchanger
 iii) U-bend double tube sheet exchanger
 b) Discuss the factors to be considered in the selection of heat exchanger type. 08
- Q.5** a) Obtain the expression for exchanger heat transfer effectiveness ϵ , for counter flow. 10
 b) Discuss the important features of plate heat exchanger. 10
- Q.6** a) Water at a flow rate of 5000 kg/hr will be heated from 20°C to 35°C by hot water at 140°C. A 15°C hot water temperature drop is allowed. A number of 3.5 m hairpins of 3 in. (ID = 0.0779 m) by 2 in. (ID = 0.0525 m, OD = 0.0603 m) counterflow double-pipe heat exchangers with annuli and pipes, each connected in series, will be used. Hot water flows through the inner tube. Fouling factors are: $R_{fi} = 0.000176 \text{ m}^2 \text{ K/W}$, $R_{fo} = 0.000352 \text{ m}^2 \text{ K/W}$. Assume that the pipe is made of carbon steel ($k = 54 \text{ W/m K}$). Calculate the number of hairpins. 20
 Properties of hot water are: $\rho = 932.5 \text{ kg/m}^3$, $C_p = 4.268 \text{ kJ/kg K}$, $k = 0.687 \text{ W/m K}$, $\mu = 0.207 \times 10^{-3} \text{ Pa.s}$, $Pr = 1.28$;
 Properties of cold water are: $\rho = 996.4 \text{ kg/m}^3$, $C_p = 4.179 \text{ kJ/kg K}$, $k = 0.609 \text{ W/m K}$, $\mu = 0.841 \times 10^{-3} \text{ Pa.s}$, $Pr = 5.77$