ME/Sem-II/MECH THRM/CBCGS/ND-18/22-11-2018

Time : 3 Hrs **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) Explain in brief: **10**
   a) Constructional details of Shell and Tube Heat Exchanger
   b) Effects of fouling on Heat Exchanger performance

b) Discuss the various components of pressure drop considered while calculating the total shell side pressure drop? **10**

Q.2 a) Outline the step by step thermal hydraulic design procedure for design /performance analysis of Gaskated plate heat exchanger. **10**

b) Obtain the expression for exchanger heat transfer effectiveness ε, for counter flow. **10**

Q.3 a) i. Discuss the advantages and disadvantages of double pipe heat exchanger. **05**
ii. Discuss design of surface and evaporative condenser **05**

b) At 80 km/hr, temperature of the air entering into inner pipe (d_i = 17.5 cm), counter flow concentric tube heat exchanger is 37.8^{0}C. Water enters at 88.9^{0}C with a flow rate of 0.89 kg/s and leaves with a temperature of 82.3^{0}C. Determine the air flow rate and air outlet temperature for this heat exchanger using LMTD. Also calculate effectiveness of the heat exchanger using NTU method. Assume C_p for air and water as 1.01 kJ/kg K and 4.19 kJ/kg K resp. Take density of air as 1.127 kg/m^3. **10**

Q.4 a) i. Write in brief about cooling tower performance variable **05**
ii. What are the precautions need to be taken while designing a Heat Exchanger for corrosive environment **05**

b) List out different types of compact heat exchanger and explain any one of them. **10**

Q.5 a) Explain the important aspects of TEMA standards **10**

b) Explain in context of fouling the following: **10**
   a) What is fouling
   b) Fouling mechanism
   c) Its effects on heat transfer and pressure drop

Q.6 a) A heat exchanger is to be designed to heat raw water by the use of condensed water at 67^{0}C and 0.2 bar, which will flow in the shell side with a mass flow rate of 50,000 kg/hr. The heat will be transferred to 30, 000 kg/hr of city water coming from a supply at 17^{0}C (C_p = 4184 J/kg K). A single shell and single pass is preferable. A fouling resistance of 0.000176 m^2 K/W is suggested with 35 % surface over design, whichever is smaller. A maximum coolant velocity of 1.5 m/s is suggested to prevent erosion. A maximum tube length of 5 m is required because of space limitations. The tube material is carbon steel (k = 60 W/m K). Raw water will flow inside of ¾ in. straight tube (19 mm O.D. and 16 mm I.D.). Tubes are laid out on a square pitch with a pitch ratio of 1.25. Perform Preliminary analysis. Assume suitable data if necessary. **20**

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