Roll No. | | | | | | | | | | |

B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2014

MECHANICAL ENGINEERING

VIII Semester

Subject code & Subject Title: ME9039 DESIGN OF HEAT EXCHANGERS

(Regulation 2008)

Time: 3 Hours | Answer ALL Questions | Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. Give some examples of regenerative heat exchangers
2. Define area density and its limitations
3. What is the role of pressure drop in heat exchanger design?
4. List out the mechanical fouling control technique
5. Which type of shell is used in condenser for better performance? Why?
6. Explain spacing and baffle cut?
7. What is heat capacity rate?
8. Compare drift and evaporation rate
9. What is the need of multipass heat exchangers?
10. Why fouling is less in plate heat exchanger than tube exchanger?

Part – B (5 x 16 = 80 marks)

11. Classify heat exchangers according to Flow type, transfer type and construction type and explain the characteristics of each type (16)

12. a) i) Explain the steps and correlations involved in KERN method analysis (10)

ii) What are the common approximations made in the analysis of heat exchanger? (6)

OR

b) i) What are the common causes of fouling in a heat exchanger? How does fouling effect heat transfer and pressure drop? (12)

ii) How does the log mean temperature difference for a heat exchanger differ from the arithmetic mean temperature difference? (4)

13. a) Find the heat transfer coefficient for the shell and tube heat exchanger with the following specifications by using Kern's method.(Length of shell L_s=5m, Shell diameter D_s=1.2m, outside diameter of tube D_o=32mm, Tube pitch (triangular), P_t= 50mm, Baffle spacing L_b=150mm, Baffle thickness t_b=4mm,)

The following fluid specifications are: Mass flow rate m= 6 kg/s, Density ρ= 840 kg/m^3, specific heat capacity C_p=2.55 kj/kg, Dynamic viscosity μ=0.482X10^{-3} Ns/m^2, thermal conductivity k=0.11 w/mk. (16)

OR

b.) i) Design a two pass shell and tube heat exchanger to supply vapour for the turbine of an OTEC system based on standard power cycle is to generate 2 MW at efficiency of 3%. Ocean water enters the tubes of the exchanger at 300K and its desired outlet temperature is 292K. The working fluid of the power cycle is evaporated in the tubes of the exchanger at its phase change temperature of 290K and over all heat transfer co efficient is 1200 w/m^{2}k. (10)

ii) What is the role of the baffles in a shell and tube heat exchanger? How does the presence of baffles affect the heat transfer and the pumping requirements? Explain (6)

14. a.) i) Compare from the ease of repair point of view the following heat exchangers, 1) Spiral heat exchanger 2) Tubular heat exchanger 3) Plate heat exchanger (6)

ii) What are the advantages and the limitations of gasketed-plate heat exchangers? (10)

OR

b.) Air at 1 atm and 400k and with a velocity of U_∞=10m/s flows across a compact heat exchanger matrix. Calculate the heat transfer coefficient and frictional pressure drop for the air side. The length of the matrix is 0.6 m. (σ=0.534 and D_h=0.3633 cm) (16)

15. a.) Cold water will be heated by a waste water stream. The cold water with a flow rate of 140kg/s enters the gasketed-plate heat exchanger at 22°Cand will be heated to 42°C. the waste water has the same flow rate entering at 65°C and leaving at 45°C.The maximum permissible pressure drop for each stream is 3.45 bar. Determine the heat transfer coefficient for both fluids.

(N_t=105, L_v=1.55m, L_C=0.38m, L_w=0.63m, A_e=110m^2, φ=1.255) (16)

OR

b) shell and tube heat exchanger condenser is to be designed for a coal fired power station of 200MW. Steam enters the turbine at 5Mpa and 400°C.(h_i=3195.7kj/kg).the condenser pressure is 10 kpa. The thermodynamic efficiency of the turbine is 85%. The actual enthalpy of steam entering the condenser at 0.1 bar is 2268.4kj/kg with 80% quality and exit is 1191.8 kj/kg. There is no sub cooling. A single tube pass is used and the cooling water velocity is assumed to be 2 m/s. cooling water is available at 20°C and exit at 30°C.allowable total pressure drop on tube side 35kpa. The tube wall thermal conductivity K=111 w/mk.(d_o=0.0254m,d_i=0.02291m, C_{pc}=4180j/kgk T_s=45.8°C, R_{fi}=0.0018 m^2k/w,R_{fo}=0.00009 m^2k/w) (16)

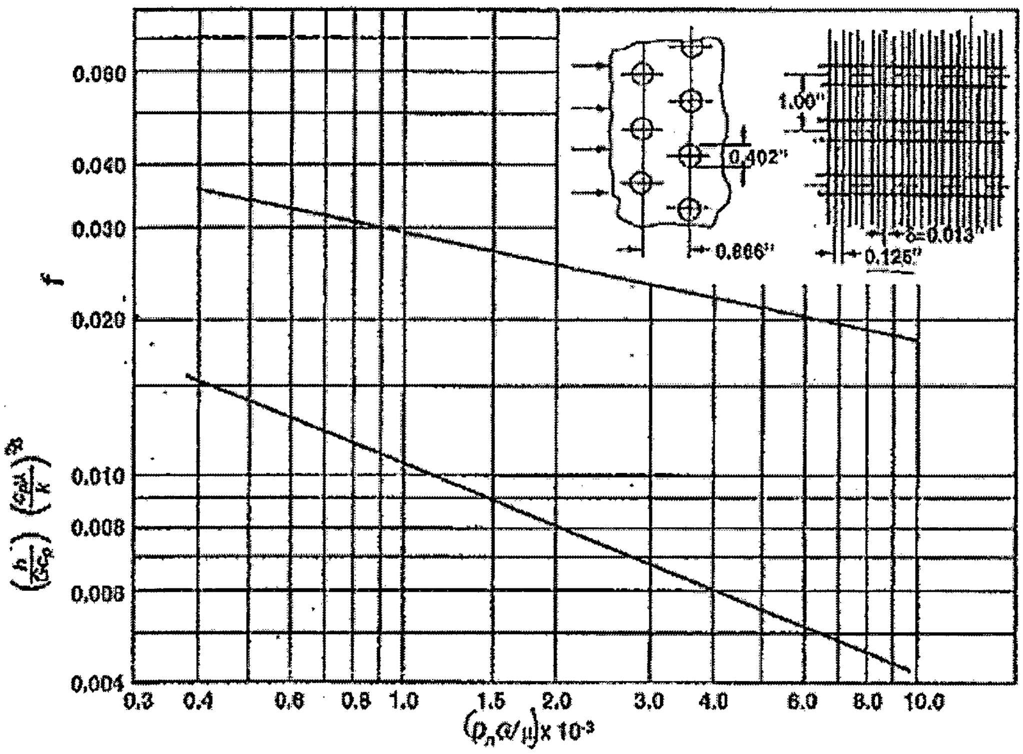

Figure 14 (b)