Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
ME – SEMESTER II (OLD) EXAMINATION – SUMMER 2017

Subject Code:1722101 **Date:09/05/2017**
Subject Name: Design of Heat Exchange Equipments
Time:10:30 A.M. to 01:00 P.M. **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 (a) According to flow arrangements, classify heat exchanger equipments. 07
(b) Explain heat exchanger design methodology 07

Q.2 (a) Derive the equation for heat transfer effectiveness in case of parallel flow heat exchanger. 07
(b) A counter-flow double pipe heat exchanger using superheated steam is used to heat water at the rate of 10500 kg/h.The steam enters the heat exchanger at 180 °C and leaves at 130 °C.The inlet and exit temperatures of water are 30 °C and 80 °C respectively.If overall heat transfer co-efficient from steam to water is 814 W/m^2 °C,calculate heat transfer area.What would be the increase in area if the fluid flows were parallel ? 07

OR

(b) 16.5 kg/s of the product at 650 °C (c_p=3.55 kJ/kg°C),in a chemical plant ,are to be used to heat 20.5 kg/s of the incoming fluid from 100°C (c_p=4.2 kJ/kg°C).If the overall heat transfer co-efficient is 0.95 kW/m^2°C and the installed heat transfer surface is 44 m^2 ,calculate the fluid outlet temperatures for the counter-flow and parallel flow arrangements. 07

Q.3 (a) What is fouling ? Explain types and mechanisms of fouling. 07
(b) Explain the following:
J-factors, fouling factor, Economic analysis of compact heat exchanger 07

OR

Q.3 (a) Explain the design of double pipe heat exchangers. 07
(b) In a 1-2 TEMA E shell -and -tube exchanger, water enters the shell at 21 °C at a rate of 1.4 kg/s. Engine oil flows through the tubes at a rate of 1.0 kg/s. The inlet and outlet temperatures of the oil are 150 °C and 90 °C respectively. Determine the surface area of the exchanger by both the MTD and ε-NTU methods if U=225 W/m^{2}K. The specific heats of water and oil are 4.19 J/g. K and 1.67 J/g. K respectively. 1

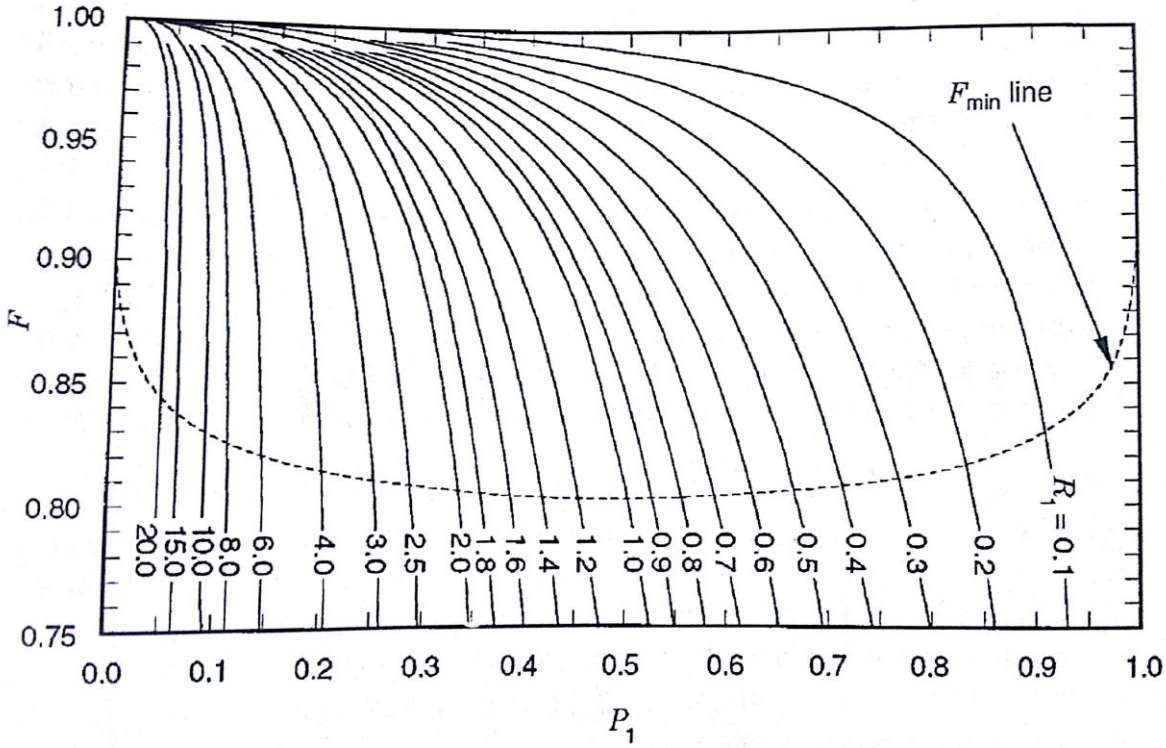

Fig.1 LMTD correction factor F as a function of P_1 and R_1 for a 1-2 TEMA E shell-and-tube exchanger with the shell fluid mixed

Q.4 (a) Compare "welded plate heat exchanger" and " plate and frame heat exchanger" 07

(b) Explain step by step design procedure of shell and tube heat exchanger. 07

OR

Q.4 (a) Explain the classification of shell and tube type heat exchangers as per TEMA standards.Draw the sketch of shell and tube type heat exchangers and label the different parts. 07

(b) Steam condenses at atmospheric pressure on the external surface of the tubes of a steam condenser. The tubes are 12 in number and each is 30 mm in diameter and 10 m long.The inlet and outlet temperatures of cooling water flowing inside the tubes are 25 °C and 60 °C respectively. The value of h_{fg} is 2257 kJ/kg at the atmospheric pressure. If the flow rate is 1.1 kg/s, calculate the following:

(i) The rate of condensation of steam

(ii) The mean overall heat transfer coefficient based on the inner surface area

(iii) The number of transfer units and

(iv) The effectiveness of the condenser 07

Q.5 (a) Explain the following design considerations for a heat exchanger

(i) Pumping power

(ii) Prediction of heat transfer coefficient

(iii) Size and weight of heat exchanger 07

(b) Explain in detail construction and design of industrial condensers. 07

OR

Q.5 (a) Write brief note on compact heat exchanger. 07

(b) State design considerations for a coal based furnace. 07