QPC: RN18001290 AR - 18 Reg. No.

GIET MAIN CAMPUS AUTONOMOUS GUNUPUR – 765022

B. Tech Degree Examinations, November – 2021

(Seventh Semester)

BMEPE7041 – Design and Analysis of Heat Exchanger

(Mechanical Engineering)

Time: 3 hrs Maximum: 100 Marks

Answer ALL Questions

The figures in the right hand margin indicate marks.

PART – A: (Multiple Choice Questions) (2 x 10 = 20 Marks)

Q.1. Answer ***ALL*** questions [CO#] [PO#]

a. In a heat exchanger, it is observed that $\Delta T_1=\Delta T_2$, where ΔT_1 is the temperature difference between the two single phase fluid streams at one end and ΔT_2 is the temperature difference at the other end. This heat exchanger is CO1 PO1

i. a condenser ii. an evaporator
iii. a counter flow HEx iv. A parallel flow HEx

b. In shell and tube heat exchanger, baffles are mainly used to CO1 PO1

i. Increase the mixing of fluid ii. Increase the heat transfer area
iii. deflect the flow in desired direction iv. Reduce fouling of the tube surface

c. Heat Capacity is defined as the product of CO2 PO1

i. Mass and temperature ii. Mass and specific heat
iii. Specific heat and temperature iv. Time and temperature

d. In a condenser of a power plant, the steam condenses at a temperature of 60ºC. The cooling water enters at 30°C and leaves at 45°C. The logarithmic mean temperature difference (LMTD) of the condenser is CO2 PO2

i. 16.2° C ii. 21.6° C
iii. 30° C iv. 37.5° C

e. For a heat exchanger, ΔT_{max} is the maximum temperature difference and ΔT_{min} is the minimum temperature difference between the two fluids. LMTD is the log mean temperature difference. C_{min} and C_{max} are the minimum and the maximum heat capacity rates. The maximum possible heat transfer (Q_{max}) between the two fluids is CO2 PO1

i. C_{min} LMTD ii. $C_{min}\ \Delta T_{max}$
iii. $C_{max}\ \Delta T_{max}$ iv. $C_{max}\ \Delta T_{min}$

f. LMTD in case of counter flow heat exchanger as compared to parallel flow heat exchanger is CO2 PO1

i. Higher ii. Lower
iii. Same iv. Depends on the area of heat exchanger

g. The heat exchanger is said to be compact when its area density is CO2 PO1

i. equal to 700 m^2/m^3 ii. less than 700 m^2/m^3
iii. more than 700 m^2/m^3 iv.unpredictable

h. Which of the following is not a property of Plate type heat exchangers? CO3 PO1

i. Even though the heat exchanger has low hydraulic diameter, it can be readily and easily cleaned ii. Leakage is never a concern in these heat exchangers
iii. It provides a very large surface area for heat transfer iv. The net weight required is always less than its equivalent Shell and tube type heat exchanger

i. Cooling tower effectiveness is the ratio of CO3 PO1

i. Range / (range + approach) ii. Approach / (range + approach)
iii. Range / Approach iv. Approach / Range

j. How does outside air enter into the wet cooling system? CO3 PO1
i. Air vents ii. Louvers
iii. Tuyeres iv. Vacuum

PART – B: (Short Answer Questions) (2 x 10 = 20 Marks)

Q.2. Answer ***ALL*** questions	[CO#]	[PO#]
a. What is fouling factor?	CO1	PO1
b. Are we really getting extra advantage by providing Baffles in Shell and tube heat exchanger Justify your answer.	CO3	PO1
c. What do you mean by correction factor for a cross flow heat exchanger?	CO1	PO1
d. Are we really getting extra advantage by providing Baffles in Shell and tube heat exchanger Justify your answer.	CO2	PO1
e. Water is flowing through a 12 mm tube filling 80% of its cross section. What is its hydraulic diameter?	CO4	PO2
f. What is the purpose of using baffles in a heat exchanger?	CO2	PO1
g. What will be the heat capacity rate of a fluid during boiling? Justify your answer.	CO3	PO1
h. In a liquid to gas heat exchanger, it is best to put extended surfaces on the gas side. Why?	CO3	PO1
i. In which side of a STHE it is recommend to pass a corrosive fluid and why?	CO2	PO1
j. What do you understand by boiling point rise?	CO2	PO1

PART – C: (Long Answer Questions) (15 x 4 = 60 Marks)

Answer ***ALL*** questions	Marks	[CO#]	[PO#]
3. a. In a shell and tube counter flow heat exchanger, water flows through a copper tube of 20 mm ID and 23 mm OD. Oil passes through the shell. Water enters at 20 ^oC and leaves at 30 ^oC. Oil enters at 75 ^oC and leaves at 60 ^oC. Water and oil have the coefficients of 4500 and 1250 W/m^2 K respectively. Thermal conductivity of the tube wall is 355 W/ m-K. The fouling factor for water and oil are 0.0004 and 0.0001 respectively. If the length of the tube is 2.4 m, Calculate (i) overall Heat transfer coefficient and (ii) The heat transfer rate.	15	CO1	PO2
(OR)			
b. Derive expression for overall Heat Transfer coefficient for double pipe heat exchanger	10	CO1	PO1
c. Classification of Heat Exchanger according to Transfer Process.	5	CO1	PO1
4. a. Derive Expression for Effectiveness of counter flow heat exchanger and also express the value of ' ε ' when R= 1.	15	CO2	PO1
(OR)			
b. Hot Gases are used in a finned tube heat exchanger to heat 2.5 kg/S of water (c = 4.18 kJ / kg ^oC) from 35 ^oC to 85 ^oC. The gases (c = 1.09 kJ / kg ^oC) enter as 200 ^oC and leaves at 93 ^oC. Overall heat transfer coefficient is 180 W/m^2 ^oC. Calculate the area of the Heat Exchanger and the effectiveness. Take NTU = 1.4.	15	CO3	PO2
5. a. A single effect evaporator with 12 m^2 of heating surface is used to concentrate NaOH solution from 10% to 50% solids, the feed being 2000kg/hr. The feed enters at 50^{0}C and has a specific heat of 0.80 kcal/kg.^{0}C. The pressure in the vapour space is 10 cm Hg absolute. 920 kg/hr of steam of 102^{0}C are used. Calculate the apparent overall heat transfer coefficient. Boiling point of 50% NaOH solution = 87^{0}C.	15	CO3	PO2

(OR)

b.	A Steam condenser is 4 m long and contains 2000 brass tubes of 1.59 cm OD each. In attest 125 kg/s of cooling water at 22^0c is supplied to the condenser and when the steam pressure in the shell is 61mm of Hg , the condensate is produced at 3.05 kg/s. Determine : a. Effectiveness of the heat exchanger b. Overall heat transfer coefficient. Take $C_{p\ water}$ = 4.178 kJ/Kg K	15	CO3	PO2
6. a.	The cooling water used in a power plant consists of 10 big fans. The quantity of cooling water circulated through the tower is 1000 kg/minute and it is cooled from 35 ^{o}C to 30 ^{o}C. The atmospheric conditions are 35 ^{o}C DBT and 25 ^{o}C WBT. The air leaves the tower at 30 ^{o}C and 90% R.H. find out: a. The quantity of air handled per fan per minute b. The quantity of make-up water per hour. Neglect the loss due to carry over and heat losses.	15	CO4	PO2

(OR)

b.	Explain how the makeup water requirement is estimated from energy and mass balance of a cooling tower.	8	CO2	PO1
c.	Classify Cooling towers and explain in which season the performance of cooling tower will be more.	7	CO2	PO1

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