QP Code: R262B038 Reg. No | | | | | | | | | | AY 25

Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET University)

M.Tech. (Second Semester - Regular) Examinations, May – 2026

24MTEPE12002 – Design of Heat Exchangers

Time: 3 hrs Maximum: 60 Marks

Answer ALL questions
(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions		CO #	Blooms Level
a.	Classify heat exchangers based on transfer process and flow arrangement.	CO1	K2
b.	Explain compact heat exchangers and the significance of area density.	CO3	K3
c.	State the assumptions used in heat exchanger analysis.	CO2	K2
d.	Discuss the effects of fouling in heat exchangers.	CO5	K3
e.	Explain the causes and minimization of flow induced vibrations in heat exchangers.	CO6	K3

PART – B **(10 x 5 = 50 Marks)**

Answer ***ALL*** the questions		Marks	CO #	Blooms Level
2. a.	Explain the classification of heat exchangers based on transfer process, construction, and flow arrangement.	5	CO1	K3
b.	Differentiate between regenerators and recuperators with suitable applications.	5	CO1	K3
	(OR)			
c.	A counter flow heat exchanger is employed to cool 0.55 Kg/sec (Cp = 2.45 KJ/Kg°C) of oil from 115°C to 40°C by the use of water. The inlet and outlet temperatures of cooling water are 15°C and 75°C, respectively. The overall heat transfer coefficient is expected to be 1450 w/m2°C. Using NTU method, calculate the Effectiveness of heat exchanger, surface area required and the mass flow rate of water.	10	CO1	K3
3.a.	Derive the expression for LMTD in a counter-flow heat exchanger and explain its importance.	5	CO2	K3
b.	Explain the effectiveness-NTU method and state when it is preferred over the LMTD method.	5	CO2	K2
	(OR)			
c.	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 °C and leaves at 30 °C. Oil enters at 75 °C and leaves at 60 °C. Water and oil have the coefficients of 4500 and 1250 W/m2 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.	10	CO2	K3
4.a.	In a shell and tube heat exchanger, determine the overall heat transfer coefficient considering fouling factors.	5	CO4	K3
b.	Analyse the causes of pressure drop in shell and tube heat exchangers.	5	CO4	K3
	(OR)			
c.	Hot Gases are used in a finned tube heat exchanger to heat 2.5 kg/S of water (c = 4.18 kJ / kg °C) from 35 oC to 85 °C. The gases (c = 1.09 kJ / kg °C) enter as	10	CO4	K3

	200 ^{o}C and leaves at 93 ^{o}C Overall heat transfer coefficient is 180 W/m2 ^{o}C. Calculate the area of the Heat Exchanger and the effectiveness. Take NTU = 1.4.			
5.a.	Discuss design standards and material selection criteria for heat exchangers.	5	CO5	K3
b.	Explain thickness calculation of shell, tubes, and tube sheets in heat exchangers.	5	CO5	K3
	(OR)			
c.	Calculate the makeup water required for a cooling tower system circulating the water of 5000m^{3}/hr. The cooling range is 12 ^{o}C and allowable concentration ratio is 3. Assume that an evaporation loss is 2% of the recirculation water quantity for every 6 ^{o}C of cooling range and drift and windage loss is 0.2%. The blow down is given by B= (E/(C-1)) – W , where C is permissible concentration ratio (total dissolved solids in the circulating water / total dissolved solids in make-up water).	10	CO5	K3
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 The quantity of air handled per fan per minute and The quantity of make-up water per hour. Neglect the loss due to carry over and heat losses.	10	CO6	K4
	(OR)			
b.	Cold water enters a counter-flow heat exchanger at 10°C at a rate of 8 kg/s, where it is heated by a hot water stream that enters the heat exchanger at 70°C at a rate of 2 kg/s. Assuming the specific heat of water to remain constant at Cp = 4.18 kJ/kg · °C, determine the maximum heat transfer rate and the outlet temperatures of the cold and the hot water streams for this limiting case.	10	CO6	K4

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