Model Question Paper-1/2 with effect from 2022-23 (CBCS Scheme)

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Fourth Semester B.E. Degree Examination
Process Heat Transfer

TIME: 03 Hours **Max. Marks: 100**

Note: Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

		Module -1	*Bloom's Taxonomy Level	Marks
Q.01	a	State and explain the basic modes of heat transfer	L2	6
	b	Derive an expression for steady state heat transfer through a multi layered plane wall	L2	8
	c	Estimate the heat loss per m^2 of the surface through a brick wall 0.5 m thick when the inner surface is at 400 K (127 $^{\circ}$C) and the outside surface is at 310 K (37 $^{\circ}$C). The thermal conductivity of the brick may be taken as 0.7 W/(m·K).	L3	6
		OR		
Q.02	a	Derive an expression for steady state heat transfer through multi layered plane cylinder	L2	8
	b	88 mm O.D. pipe is insulated with a 50 mm thickness of an insulation having a mean thermal conductivity of 0.087 W/(m·K) and 30 mm thickness of an insulation, having mean thermal conductivity of 0.064 W/(m·K). If the temperature of the outer surface of the pipe is 623 K (350 $^{\circ}$C) and the temperature of the outer surface of insulation is 313 K (40 $^{\circ}$C), calculate the heat loss per metre of pipe.	L3	8
	c	Explain in brief about the types of insulation.	L2	6
		Module-2		
Q. 03	a	What are fins? How are they classified? Derive efficiency of a longitudinal fin	L2	8
	b	Derive relation for overall heat transfer coefficient in terms of individual heat transfer coefficient in case of a single wall.	L2	8
	c	Differentiate between natural and forced convection	L2	4
		OR		
Q.04	a	A hot fluid enters a double pipe heat exchanger at a temperature of 423 K (150 °C) and is to be cooled to 367 K (94 °C) by a cold fluid entering at 311 K (38 °C) and heated to 339 K (66 °C). Shall they be directed in parallel or counter-current flow ?	L3	10
	b	Using dimensional analysis derive an expression between Nusselet number, Reynolds number and Prandtl number in forced convection.	L2	10
		Module-3		
Q. 05	a	With the assumptions explain Reynolds analogy, and how does it relate the momentum transfer to heat transfer in fluid flow?	L2	10
	b	Explain the construction and working of DPHE with neat sketch	L2	10
		OR		
Q. 06	a	Explain the construction and working of 1-2 pass shell and tube heat	L2	10

		exchanger with neat sketch		
	b	Explain dropwise and film wise condensation mechanism and compare their merits and demerits.	L2	10
		Module-4		
Q. 07	a	Give the stepwise procedure for the design of shell and tube heat exchanger with suitable equations.	L2	10
	b	Calculate the heat transfer area of a 1-2 heat exchanger from the following data : Inlet and outlet temperatures of the hot fluid are 423 K (150 °C) and 353 K (80 °C) respectively. Inlet and outlet temperatures of the cold fluid are 303 K (30 °C) and 318 K (45 °C) respectively. Overall heat transfer coefficient = 4100 W/(m^2·K) Heat loss = 407 kW L.M.T.D. correction factor = 0.84	L3	10
		OR		
Q. 08	a	Give the stepwise procedure for the design DPHE with suitable equations.	L2	10
	b	A hot fluid enters a double pipe heat exchanger at a temperature of 423 K (150 °C) and to be cooled to 363 K (90 °C) by a cold fluid entering at 308 K (35 °C) and heated to 338 K (65 °C). Shall they be directed in parallel flow or counter current flow to have a high rate of heat transfer ?	L3	10
		Module-5		
Q. 09	a	With a neat sketch explain different methods of feeding to the multiple effect evaporator system.	L2	8
	b	An evaporator operating at atmospheric pressure (101.325 kPa) is fed at the rate of 10000 kg/h of weak liquor containing 4 % caustic soda. Thick liquor leaving the evaporator contains 25% caustic soda. Find the capacity of the evaporator.	L3	6
	c	Write a short note on the following: i) Kirchchhoff's law, ii) Stefen Boltzmann law	L2	6
		OR		
Q. 10	a	Write a short note on the following i) Weins Displacement Law, ii) Black body radiation.	L2	4
	b	Calculate the heat loss by radiation from an unlagged horizontal steam pipe, 50 mm o.d. at 377 K (104 °C) to air at 283 K (10 °C).	L3	6
	c	A 50 mm i.d. iron pipe at 423 K (150 ° C) passes through a room in which the surroundings are at 300 K (27 °C). If the emissivity of the pipe metal is 0.8, what is the net interchange of radiation energy per meter length of pipe ? The outside diameter of pipe is 60 mm.	L3	6

*Bloom's Taxonomy Level: Indicate as L1, L2, L3, L4, etc. It is also desirable to indicate the COs and POs to be attained by every bit of questions.