Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V(New) • EXAMINATION – WINTER 2016

Subject Code:2153502 Date:19/11/2016

Subject Name:Introduction to Heat Transfer

Time:10:30 AM to 01:00 PM Total Marks: 70

Instructions:

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

			MARKS
Q.1		**Short Questions**	**14**
	1	What is fouling in Heat Exchanger ?	
	2	What is shape factor ?	
	3	What is the role of baffles in a shell and tube heat exchanger?	
	4	What is Wein's law?	
	5	Define term absorptivity.	
	6	What do you mean by optimum thickness of insulation ?	
	7	What is the function of sealing strip in shell and tube heat exchanger?	
	8	Define thermal conductivity.	
	9	How to define monochromatic emmisive power ?	
	10	What do you mean by capacity of an evaporator ?	
	11	State kirchoff's law.	
	12	Define steam economy of an evaporator.	
	13	A small blackbody has a total emissive power of 4 kW/m^2. Determine it's surface temperature.	
	14	Define: Radiosity.	
Q.2	**(a)**	What do you mean by a Black body ?	**03**
	(b)	What are the important dimensionless groups in convection heat transfer? Explain any three with their physical significance.	**04**
	(c)	A furnace with a steel door, having an inner lining of an insulating material, is at a temperature of 65^0C. The door, 1.5 m high and 1m wide, loses heat to an ambient at 25^0C. Calculate the rate of heat loss from door at steady state. k= 0.028 W/m^0C, Kinematic viscosity $=1.85*10^{-5}$ m^2/s, Prandtl number=0.695	**07**
		OR	
	(c)	Determine the rate of heat loss from 100 mm diameter steam pipe placed horizontally in ambient air at 30^0C. The length of pipe is 4 m and wall temperature is 170 ^{0}C. k = 0.0322 W/mK, Kinematic viscosity $=23.31*10^{-6}$ m^2/s, Prandtl number=0.69.	**07**
Q.3	**(a)**	Write a short note on Reynold's analogy.	**03**
	(b)	Using Fourier's law derive an expression for heat transfer by conduction through cylindrical surface.	**04**
	(c)	Explain concept of critical thickness of insulation and derive equation for the critical thickness of insulation for cylinder.	**07**
		OR	
Q.3	**(a)**	State the lambert's Cosine law and prove that intensity of radiation in any direction is the same for surface which obey cosine law.	**03**
	(b)	In view of unsteady state heat transfer with negligible internal resistance explain physical significance of biot and fourier number.	**04**
	(c)	A liquid metal flow at a rate of 5kg/s through 5 cm diameter steel tube. It enters at 425 ^{0}C and it's heated to 450 ^{0}C as its passes through the tube. If a constant heat flux maintained along the tube and tube	**07**

wall is at a temperature 20^0C higher than the liquid metal bulk temperature, calculate the area required to effect the heat transfer. Properties of the compound: viscosity $=1.34*10^{-3}$ kg/ms, Cp for Steel=0.149 KJ/kgK, K_{Steel} = 15.6 W/mK. A constant heat flux,

$$\mathbf{Nu = 4.82 + 0.0185\ Pe^{0.87}}$$ relation hold good

Q.4	**(a)**	Classify the Heat Exchangers.	**03**
	(b)	Give difference between drop wise and film wise condenstation.	**04**
	(c)	Derive the equation for L.M.T.D. in parallel flow heat exchanger. State all the assumption made in derivation.	**07**

OR

Q.4	**(a)**	Discuss construction of double pipe heat excahneger with diagram.	**03**
	(b)	Write a brief on plate heat exchanger.	**04**
	(c)	What do you mean by effectiveness of heat exchanger? Derive a relationship between effectiveness and number of transfer units for a counter flow exchanger.	**07**
Q.5	**(a)**	What is nucleate boiling and film boiling ?	**03**
	(b)	Discuss in brief about Boiling point elevation.	**04**
	(c)	Discuss Agitated thin film evaporators with neat and clean diagram and its application.	**07**

OR

Q.5	**(a)**	State the advantages of forced circulation evaporators and its application.	**03**
	(b)	Explain about various feed arrangement used in multiple effect evaporator.	**04**
	(c)	Benzene from the condenser at the top of distillation column is cooled at a rate of 1000 kg/h from 75^0C to 50 ^{0}C in a counter current double pipe heat exchanger. The construction of heat exchanger is hair pin with effective length of 25 m. The inner tube is of carbon steel, 25 mm o.d., 14 BWG. The outer pipe is schedule 40, 1.5 inch NB (Nominal Bore). Benzene flows through annulus. Water which flow through inner tube, entering at 30^0C and leaving at 40^0C, is the coolant. Calculate the individual heat transfer coefficients based on both inside and outside. Inner tube: OD = 25.4 mm, Wall thickness = 2.2 mm; thermal conductivity of the tube wall =74.5 W/mK. Outer pipe: ID= 41 mm, OD=48 mm. Thermophysical properties of benzene at average temperature. (62.5^0C): Cp=1.88 kJ/kg^{0}C; Viscosity =0.37 cP, Density=830 kg/m^3. k=0.154 W/mK. Properties of water at average temperature (35^0C): Cp= 4.187 kJ/kg^{0}C; Viscosity =0.8 cP, k=0.623 W/mK.	**07**

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