Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–VI • EXAMINATION – WINTER 2013

Subject Code: X61903 Date: 09-12-2013

Subject Name: Heat and Mass Transfer

Time: 02.30 pm - 05.00 pm 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)** A wall is made up of three layers, one of red brick, one of insulating brick and one of fire brick. The inner and outer surfaces are at 1043 K and 213 K respectively. The respective co-efficient of thermal conductivities of the layers are 0.75, 0.12 and 1 W/m-K and the thicknesses are 11 cm, 7.5 cm and 22 cm. Find the rate of heat loss per sq. meter per hour and interface temperatures. **07**

(b) Derive general conduction equation in Cartesian coordinate and reduce the same for one dimensional heat conduction. **07**

Q.2 **(a)** Explain the following terms: (Any THREE) **06**

(1) Convection
(2) Radiation
(3) Pool boiling
(4) Emissive power

(b) If the velocity distribution in the boundary layer of a flat plate is given by an expression, $u/U = \sin \pi/2(y/\delta)$ Then find the expression for the boundary layer thickness. **08**

OR

(b) Derive momentum equation for hydrodynamic boundary layer over a flat plate. **08**

Q.3 **(a)** Derive an expression for LMTD for parallel flow heat exchanger. **07**

(b) Explain fouling of heat exchanger in detail. **07**

OR

Q.3 **(a)** Derive the expression for effectiveness of parallel flow heat exchanger. **07**

(b) Air enters a cooler at 115˚C and at 3bar and is brought to 45˚C by passing through tubes of 10 mm surrounded by water which enters the cooler at 15˚C and leaves at 30˚C. Assuming the heat exchanger is counter flow, find the mean temperature difference. If the air velocity in the tube is limited to 6.5 m/sec. find the length of the tube required. Neglect the tube resistance and assume water side heat transfer coefficient is 200 W/m^2K. **07**

Take the following properties of air at mean temperature.

Density = 2.87 kg/m^3, C_p = 1005 J/kg.K, K = 0.03 W/m.K, $\mu = 20.92 \times 10^{-6}$ kg/m.sec, $v = 20.92 \times 10^{-6}$ m^2/sec.

Q.4 **(a)** (i) Explain emissivity and absorptivity of a surface. Also differentiate between black body and grey body. **07**

(ii) Explain Wein's displacement law of radiation.

(b) By dimensional analysis show that for forced convection heat transfer the Nusselt number can be expressed as a function of Prandtl number and Reynolds number. **07**

OR

Q.4 **(a)** Derive an expression for heat dissipation in Rectangular Fin of uniform cross section which is insulated at tip. **07**

	(b)	Derive the expression for radiant heat exchange between two finite black surfaces by radiation.	**07**
Q.5	**(a)**	Discuss various regimes of pool boiling.	**07**
	(b)	Distinguish between the mechanism of filmwise and dropwise condensation.	**07**

OR

Q.5	**(a)**	Show physical significance of Following non-dimensional numbers: Nu (Nusselt Number), Gr (Grashof Number), Pr (Prandtl Number), and Re (Reynold Number).	**07**
	(b)	State and explain Fick's law of diffusion.	**07**

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