Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI- EXAMINATION – SUMMER 2016

Subject Code:161906 **Date:13/05/2016**

Subject Name:Heat and Mass 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.**

Q.1 **(a)** Derive general heat conduction equation in cylindrical coordinate system. **07**

(b) With the help of a neat sketch explain the various boiling regimes in the case of a pool boiling operation. **07**

Q.2 **(a)** State and explain (i) Critical thickness of insulation (ii) efficiency of fins (iii) effectiveness of fins **06**

(b) A cold storage room has walls made of 180 mm of brick on the outside, 90 mm of plastic foam, and finally 20 mm of wood on the inside. The outside and inside air temperatures are 30 ^oC and -5 ^oC respectively. If the outside and inside convective heat transfer coefficients are respectively 10 and 30 $W/m^2\ ^oC$, and the thermal conductivities of brick, foam and wood are 1.0, 0.02 and 0.17 W/ m ^oC respectively. Determine: **08**

(a) overall heat transfer coefficient

(b) the rate of heat removed by refrigeration if the total wall area is 100 m^2

(c) Interface temperature between brick and plastic foam.

OR

(b) A Steel Tube (k=43.26 W/mK) of 5.08 cm. ID and 7.62 cm. OD is covered with a 2.54 cm layer of asbestos insulation (k=0.208 W/mK). The inside surface of the tube receives heat by convection from a hot gas at a temp. of T_a= 320°C with a heat transfer coefficient h_a=285 W/m^2K while the outer surface of the insulation is exposed to the ambient air at T_b=35°C with a heat transfer coefficient of h_b=20 W/m^2K. Estimate the heat loss to the ambient air for 3 m length of the tube. Draw electrical analogy , also define thermal conductivity **08**

Q.3 **(a)** Derive equations of temperature distribution and heat dissipation for fin non-insulated at tip. **07**

(b) A turbine blade made of stainless steel (k=32 W/m-k) is 60 mm long, 500 mm^2 cross-sectional area and 120 mm perimeter. The temperature of the root of the blade is 480 ^oC and it is exposed to products of combustion passing through the turbine at 828 ^oC. If the film coefficient between the blade and the combustion gases is 320 W/m^2-K, determine rate of heat flow to the blade. **07**

OR

Q.3 **(a)** Explain unsteady state heat transfer when Bi < 0.1 **07**

(b) A 1m long, 5 cm diameter, cylinder placed in an atmosphere of 40 ^oC is provided with 12 longitudinal straight fins (k = 75 W/m-K), 0.75 mm thick. The fin protrudes 2.5 cm from the cylinder surface. The heat transfer coefficient is 23.3 W/m^2-K. Calculate the rate of heat transfer if the surface temp. of cylinder is at 150 ^oC. **07**

Q.4	**(a)**	Define Re, Nu, Pr. Explain their importance in convection heat transfer.	**07**
	(b)	A horizontal fluorescent tube which is 3.8 cm in diameter and 120 cm long stands in still air at 1 bar and 20 ^{o}C. If the surface temperature is 40 ^{o}C and radiation is neglected, what is heat transfer rate by convection? Use $\overline{N}_u = 0.53\ (Gr.Pr)^{0.25}$ Take $\nu = 15.06 * 10^{-6}\ m^2/s$, Pr = 0.701, $k = 2.673*10^{-2}$ W/mK at t_{mf}	**07**

OR

Q.4	**(a)**	How are the heat exchangers classified ?	**07**
	(b)	In a shell and tube heat exchanger, 5.795 kg/s of oil flows through the shell side. The oil enters at 101 ^{o}C and leaves at 38 ^{o}C. Water flows in the tubes, entering at 32 ^{o}C and leaving at 49 ^{o}C. In addition, Cp_{oil} = 2282 J/kg.K and U = 416 W/m^2-K . Determine number of tubes, if outer diameter of tubes is 100 mm, length of each tube is 1.9 m and take correction factor as 0.88	**07**
Q.5	**(a)**	What are the fouling factors? Explain their effect in Heat Exchanger design.	**07**
	(b)	Using dimensional analysis, obtain a general form of equation for forced Convective heat transfer.	**07**

OR

Q.5	**(a)**	Define and explain Radiation shield and Radiation shape factor.	**07**
	(b)	Explain Fick's Law of Diffusion also explain its analogous with Newton's law of viscosity and Fourier's equation of heat-transfer.	**07**

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