Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – SUMMER • 2015

Subject code: 170102 **Date: 08/05/2015**

Subject Name: Theory of Heat Transfer

Time: 02.30pm-05.00pm **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 Cartesian coordinates **07**

(b) A furnace wall is made up of three layers of thickness 250 mm, 100 mm and 150 mm with thermal conductivity of 1.65 W/m-K , K_b and 9.2 W/m-K respectively. The inside is exposed to gases at 1250 ^oC with a convective heat transfer coefficient 25 W/m^2-K and the inside surface is at 1100 ^oC . the outside surface is exposed to air at 25 ^oC with convective heat transfer coefficient 12 W/m^2-K. Determine (i) the unknown thermal conductivity K_b, (ii) the overall heat transfer coefficient, (iii) All surface temperatures. Draw Electrical analogy for given system. **07**

Q.2 **(a)** Derive equations of temperature distribution and heat dissipation for fin non-insulated at tip. **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**

OR

(b) Derive and expression for "Critical thickness of insulation" for a pipe. **07**

Q.3 **(a)** Explain lumped heat capacity method and state its assumptions. **07**

(b) A titanium alloy blade of an axial compressor for which k = 25 W/m-K, ρ = 4500 kg/m^3 and Cp = 520 J/kg-K is initially at 60 °C. The effective thickness of the blade is 10 mm and it is exposed to gas stream at 600 °C, the blade experiences a heat transfer coefficient of 500 W/m^2-K. Estimate the temperature of blade after 1, 5, 20 and 100 seconds. **07**

OR

Q.3 **(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 ^oC. If the surface temperature is 40 ^oC and radiation is neglected, what is heat transfer rate by convection? **07**

Use $\overline{N}_u = 0.53\ (Gr.Pr)^{0.25}$

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**

OR

Q.4	**(a)**	Define Heat Exchanger Effectiveness & explain its significance.	**07**
	(b)	Draw and Explain boiling curve for water. Explain Nucleate boiling.	**07**
Q.5	**(a)**	Define and explain Radiation shield and Radiation shape factor	**07**
	(b)	Using dimensional analysis, obtain a general form of equation for forced Convective heat transfer.	**07**

OR

Q.5	**(a)**	State & explain Kirchoff's identity. What are conditions under which it is Applicable	**07**
	(b)	Two very large parallel plates with errissivities 0.3 and 0.8 exchange radiative energy. Polished aluminum shield ($\in$ = 0.04) is placed between two plates. Determine the percentage reduction in radiation heat transfer.	**07**

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