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GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – SUMMER 2018

Subject Code: 170102 **Date: 01-05-2018**

Subject Name: Theory of Heat Transfer

Time: 02:30 pm to 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.**
4. **Tables for properties of air and water are permitted.**

Q.1 **(a)** A gray, diffuse opaque surface (Absorptivity $\alpha = 0.8$) is at 100ºC and receives an irradiation 1000 W/m^2. If the surface area is 0.1 m^2, calculate **07**
i. Radiosity of the surface
ii. Net radiative heat transfer rate from the surface
iii. Calculate above quantities if surface is black.

(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.2 **(a)** A steam pipe pipe is covered with two layers of insulation, first layer being 3 cm thick and second 5 cm. the pipe is made from steel (k = 58 W/m-K) having ID of 160 mm and OD of 170 mm. The inside and outside film coefficients are 30 and 5.8 W/m^2-K , resp. Draw electrical analogy for system and calculate the heat lost per meter of pipe, if the steam temperature is 300 ºC and air temperature is 50 ºC. The thermal conductivity of two materials are 0.17 and 0.093 W/m-K, resp. **07**

(b) Derive general heat conduction equation in Cylindrical coordinates. **07**

OR

(b) What is the "critical radius" of insulation on a small diameter wire and a steam pipe. Explain its physical significance in both the cases & derive an expression for the same. **07**

Q.3 **(a)** Define velocity & thermal boundary layer thickness. **07**

(b) State Buckingham's π Theorem. Explain the various parameters used in the forced convection. Using Dimensional Analysis, obtain an expression for Nusselt Number in terms of Re & Pr. **07**

OR

Q.3 **(a)** Write Von-karman integral momentum equation, for the hydrodynamic laminar boundary layer of fluid flowing over stationary plate. Using this equation, derive the expression for hydrodynamic boundary layer thickness considering the cubic velocity profile. **07**

(b) Explain unsteady state heat transfer when Bi < 0.1 **07**

Q.4 **(a)** Explain term boiling also explain various regimes of boiling. **07**

(b) Explain dropwise and filmwise condensation. **07**

OR

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Q.4	**(a)**	Define Re, Nu, Pr. Explain their importance in convection heat transfer.	**07**
	(b)	What are Fourier and Biot Number? What is the physical significance of these numbers? Also Distinguish between Biot Number & Nusselt Number.	**07**
Q.5	**(a)**	Derive equations of temperature distribution and heat dissipation for Fin insulated at tip.	**07**
	(b)	How are the heat exchangers classified ? What is LMTD Correction Factor? What are the fouling factors?	**07**

OR

Q.5	**(a)**	Distinguish between: (i) A black body & grey body (ii) Specular & diffuse surfaces (iii) Absorptivity & Emissivity of a surface (iv) Total Emissivity & Equilibrium emissivity	**07**
	(b)	Define and explain Radiation shield and Radiation shape factor	**07**

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