Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VII (NEW) EXAMINATION – WINTER 2020

Subject Code:2170102 Date:21/01/2021

Subject Name:Theory of Heat Transfer

Time:10:30 AM TO 12:30 PM Total Marks: 56

Instructions:

1. **Attempt any FOUR questions out of EIGHT 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)** Explain the following terms: **03**

(a) Thermal diffusivity
(b) Thermal Conductivity
(c) Thermal contact resistance

(b) What do you understand by fin effectiveness and fin efficiency? **04**

(c) A flat plate, 1 m wide and 1.5 m long is to be maintained at 90^0C in air with a free stream temperature of 10^0C . Determine the velocity with which air must flow over flat plate along 1.5 m side so that the rate of energy dissipation from the plate is 3.75 KW. Take the following thermo-physical properties 50^0C. **07**

ρ= 1.09 kg/m^3, k= 0.028 W/m^{0}C, Pr= 0.7, μ = 2.03 x 10^{-5} kg/m-s ,
C_p= 1.007 KJ/Kg^{0}C.

Q.2 **(a)** What are Fourier and Biot numbers? Write their significance. **03**

(b) What is the "critical radius" of insulation? Derive an expression for the same for cylinders. **04**

(c) The composite wall of a furnace is made up with 120 mm of fire clay (k= 0.25 (1 + 0.0009 t) W/m^{0}C and 600 mm of red brick (k=0.8 W/m^{0}C). The inside surface temperature is 1250^0C and the outside air temperature is 40^0C. Determine : **07**

(1) The temperature at the layer interface, and
(2) The heat loss for 1 m^2 of furnace wall.

Q.3 **(a)** Differentiate between velocity and thermal boundary layer. **03**

(b) Explain lumped heat capacity method of heat transfer and state its assumptions. **04**

(c) Using dimensional analysis, obtain a general form of equation for free Convective heat transfer. **07**

Q.4 **(a)** Distinguish between natural and forced convection heat transfer. **03**

(b) Show using momentum equation that in the case of incompressible boundary layer flow with negligible pressure gradient, $\partial^3u/\partial y^3 = 0$ at y = 0. **04**

(c) Discuss the concept of thermal boundary layer in case of flow over the plates. How it differ from velocity boundary? **07**

Q.5 **(a)** Define heat exchanger and classify in detail. **03**

(b) Write a note on Nucleate boiling? **04**

(c) Derive expression for logarithmic mean temperature difference (LMTD) in the case of counter-flow-heat exchanger. **07**

Q.6 **(a)** Write assumptions used when we drive expression for LMTD for various types of heat exchangers. **03**

(b) What are the fouling factors? Explain their effect in Heat Exchanger design. **04**

(c) Prove that the effectiveness of parallel flow heat exchanger is given by $\varepsilon = \frac{1-\exp[-NTU(1+C)]}{1+C}$ **07**

Q.7 **(a)** State and Prove Kirchoff's law of radiation? **03**

(b) Differentiate between dropwise and filmwise condensation. **04**

(c) Derive a general relation for the radiation shape factor in case of radiation between two surfaces. Explain Wein's displacement law of radiation. **07**

Q.8 **(a)** Enumerate the factors on which the rates of emission of radiation by a body depend. **03**

(b) Define following: **04**

1) Gray Body
2) Lambert's Law of radiation
3) Transmissivity
4) Total Emissivity

(c) Define Radiation Intensity? Prove that the intensity of radiation is given by $I_b = E_b / \pi$ **07**

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