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

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2151909 **Date: 05/05/2017**

Subject Name: 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.**

Q.1 **Short Questions** **14**

1 Convective heat flux is ____
(a) h.A.dt (b) h.A (c) h.dt (d) None

2 The amount of radiation mainly depends upon the_____
(a) Nature of the body (b) Temperature of the body (c) type of surface of the body (d) All of these.

3 The highest thermal diffusivity is of _____
(a) Iron (b) lead (c) concrete (d) wood.

4 Thermal conductivity of solid metals with rise in temperature normally
(a) increases (b) decreases (c) remains constant (d) may increase or decrease depending on temperature (e) unpredictable

5 The rate of energy emission from unit surface area through unit solid angle, along a normal to the surface, is known as
(a) emissivity (b) transmissivity (c) reflectivity (d) intensity of radiation (e) absorptivity.

6 Emissivity of a white polished body in comparison to a black body is
(a) higher (b) lower (c) same (d) depends upon the shape of body

7 A non-dimensional number generally associated with natural convection heat transfer is (a) Grashof number (b) Nusselt number (c) Prandtl number (d) Reynold number.

8 LMTD in case of counter flow heat exchanger as compared-to parallel flow heat exchanger is (a) higher (b) lower (c) same (d) depends on the area of heat exchanger (e) depends on temperature conditions.

9 In heat exchangers, degree of approach is defined as the difference between temperatures of (a) cold water inlet and outlet (b) hot medium inlet and outlet (c) hot medium outlet and cold water inlet (d) hot medium outlet and cold water outlet (e) none of the above.

10 All radiations in a black body are ____
(a) reflected (b) refracted (c) transmitted (d) absorbed (e) partly reflected

11 The average value of Prandtl number for air is about _____
(a) 0.1 (b) 0.3 (c) 0.7 (d) 1.7 (e) 10.5.

12 The value of the wavelength for maximum emissive power is given by
(a) Stefan's law (b) Planck's law (c) Fourier's law (d) Wien's law (e) Kirchhoff's law.

13 Planck's law holds good for (a) black bodies (b) polished bodies (c) all coloured bodies (d) all of the above (e) none of the above.

14 The ratio of the emissive power and absorptive power of all bodies is the same and is equal to the emissive power of a perfectly black body. This statement is known as (a) Planck's law (b) Stefan's law (c) Wien' law (d) Krichoff's law (e) Black body law.

Q.2 **(a)** What is thermal conductivity? Explain its importance in heat conduction problems. **03**

(b) What is meant by thermal resistance? Explain the electrical analogy for solving heat problems. **04**

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

OR

(c) 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**

Q.3 **(a)** Write temperature profile equation and heat transfer from fin for **03**

1) Infinte long fin
2) Tip insultaed fin
3) Tip non insulated fin

(b) Define and Explain significance of fin effectiveness & fin efficiency. **04**

(c) 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**

OR

Q.3 **(a)** Distinguish between natural and forced convection heat transfer. **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 forced Convective heat transfer. **07**

Q.4 **(a)** Define Grashof number. Explain its significance in natural convection heat transfer. **03**

(b) Explain the concept of thermal boundary layers. **04**

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

OR

Q.4 **(a)** Why is counter-flow Heat Exchanger more effective than a parallel flow heat exchanger. **03**

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

(c) In a shell and tube heat exchanger, 6 kg/s of oil flows through the shell side. The oil enters at 105 ^oC and leaves at 40 ^oC. Water flows in the tubes, entering at 32 ^oC and leaving at 50 ^oC. In addition, $C_p$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 0.85 **07**

Q.5 **(a)** Define Radiation Intensity? Prove that the intensity of radiation is given by $I_b = E_b / \pi$ **03**

(b) State & Explain the Wien Displacement Law. Show that $E_{b\lambda}$ will be maximum when λ_{max}. T = 2900 μk **04**

(c) Consider two large parallel plates, one at temperature at 727 °C with emissivity 0.8 and other at 227 °C with emissivity 0.4. An aluminium radiation shield with an emissivity of 0.05 on both sides is placed between two plates. Calculate reduction in heat transfer rate between two plates as a result of shield. **07**

OR

Q.5 **(a)** State & explain Kirchoff 's identity. What are conditions under which it is applicable. **03**

(b) Define and explain Radiation shield and Radiation shape factor **04**

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

****