Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3151909 Date:27/01/2021

Subject Name: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.**

Q.1 **(a)** Explain aims to study 'Heat Transfer'? **03**

(b) Differentiate between: **04**
1) Conduction and radiation.
2) Counter-flow and parallel flow heat exchanger.

(c) What is meant by thermal resistance? Explain the electrical analogy for solving heat transfer problems. **07**

Q.2 **(a)** Use of aluminum material as a cooking utensils are not desirable. Evaluate. **03**

(b) Give broad classification of heat exchangers. **04**

(c) Write the most general equation in Cartesian co-ordinates for heat transfer by conduction. Deduce above equation for the following cases with suitable assumptions; **07**
(i) Laplace equation, (ii) Poisson equation, and (iii) Fourier equation.

Q.3 **(a)** In cold regions, instead of using one thick glass, two thin window glasses are preferred. Justify. **03**

(b) Differentiate between: **04**
1) Nusselt number and Reynolds number.
2) Free convection and forced convection.

(c) A cylinder in vertical position is having dimension of 18 cm diameter and length 1.5 m is maintained at a temperature of 100^0C. It is kept in atmosphere having temperature 20^0C. Calculate the heat lost by cylinder surface to the atmosphere by free convection. Properties of air at mean film temperature 60^0C are as follows : $\rho=1.06kg/m^3$, $\upsilon=18.97*10^{-6}m^2/s$, $k=0.1042kJ/m.hr.^0C$, $Cp=1.004kJ/kg^0C$. Use the relation $Nu=0.10(Gr.Pr)^{1/3}$ (The symbols have their usual meanings) **07**

Q.4 **(a)** 'It is desirable to use two thin fins instead of one thick fin for engine cooling'. Give reason. **03**

(b) Write the general differential equation in Cartesian co-ordinates for 3-D unsteady heat conduction by considering an infinitesimal volume element. Deduce there from the conduction equations for the following cases; **04**
(i) Steady state 1-D flow with heat generation at uniform rate within material, (ii) Unsteady 2-D flow without heat generation.

(c) Consider two large parallel plates, one at 1000K with emissivity 0.8 and other is at 300K having emissivity 0.6. A radiation shield is **07**

placed between them. The shield has emissivity as 0.1 on the side facing hot plate and 0.3 on the side facing cold plate.
Calculate percentage reduction in radiation heat transfer as a result of radiation shield.

Q.5 **(a)** Give applications of heat exchangers. **03**

(b) What is insulation? State its four applications in engineering field. **04**

(c) What is condensation? Explain film-wise condensation and drop-wise condensation. **07**

Q.6 **(a)** It is desirable to wear white clothes instead of black during the summer season. Give reason. **03**

(b) Give eight examples related to heat transfer from the routine life. **04**

(c) Derive the equation of LMTD for counter-flow heat exchangers. **07**

Q.7 **(a)** 'Radiator of automobiles is always painted black'. Give reason. **03**

(b) Define shape factor. Discuss salient features of shape factor. **04**

(c) An egg with mean diameter of 4 cm and initially at 20^0C is placed in a boiling water pan for 4 minutes and found to be boiled to the consumer's test. For how long should a similar egg for same consumer be boiled when taken from a refrigerator at 5^0C. Take following properties for egg : **07**
k =10W/m^{0}C, ρ=1200kg /m^3, C =2kJ/kg^{0}C, h =100W/m^2 ^{0}C

Q.8 **(a)** During the summer season, vegetable vendors are sprinkling water to keep the vegetable fresh. Evaluate in light of heat transfer. **03**

(b) Draw temperature variation for condenser and evaporator of thermal power plant. **04**

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

****