Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – SUMMER 2024

Subject Code:3151909 Date:18-05-2024

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.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	Do as directed : 1) Define : Thermal diffusivity. 2) Arrange the material in descending order of their thermal conductivity; i) Water ii) Copper iii) Air and iv) Wood. 3) Define: Anisotropic material.	**03**
	(b)	Give four examples of free convection and four examples of forced convection observed from day to day life.	**04**
	(c)	Explain the following with reference to a heat exchanger: 1. Fouling factor, 2. Effectiveness of heat exchanger, 3. Correction factor for multipass arrangement.	**07**
Q.2	**(a)**	What do you mean by radiation shiled? Give two examples of use of radiation shield.	**03**
	(b)	With suirable example, explain in brief abour black body, white body, opquae body and transperant body.	**04**
	(c)	An aluminim fin (k = 200W/mK, 2.5cm long,1m width, and 3.5mm thick) protrudes from a wall. The base is at 420^0C and surrounding air temperature is 30^0C. Determine the heat dissipated from the fin and fin efficiency for the fin is of finite length and heat loss from fin tip is negligible. Take h = 11W/m^2K.	**07**
		OR	
	(c)	A furnace wall, 32 cm thick, is made up of an inner layer of brick (k=0.84W/mK) covered with a layer of insulation (k=0.16W/mK). The furnace operates at a temperature of 1325^0C and the ambient temperature is 25^0C. i) Determine the thickness of brick and insulation which gives minimum heat loss, ii) Calculate the heat loss presuming that the insulating material has a maximum temperature of 1200^0C. If the calculated heat loss is not accepted than state whether addition of another layer of insulation would provide a satisfactory solution.	**07**
Q.3	**(a)**	Explain mean film temperature and bulk mean temperature.	**03**
	(b)	Differentiate between boiling and condensation.	**04**
	(c)	Discuss the electrical analogy for radiant heat transfer.	**07**

OR

Q.3	**(a)**	Justify that a good absorber is also a good emitter for radiation heat transfer.	**03**
	(b)	Explain in detail about cross flow heat exchanger with its advantages. Give suitable examples.	**04**
	(c)	Define condensation process. Also explain film condensation and drop-wise condensation.	**07**
Q.4	**(a)**	'It is desirable to use two thin fins instead of one thick fin for engine cooling'. Give reason.	**03**
	(b)	What is insulation? State its four applications in engineering field.	**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; (i) Laplace equation, (ii) Poisson equation, and (iii) Fourier equation.	**07**

OR

Q.4	**(a)**	Use of aluminum material as a cooking utensils are not desirable. Evaluate.	**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; (i) Steady state 1-D flow with heat generation at uniform rate within material, (ii) Unsteady 2-D flow without heat generation.	**04**
	(c)	Explain physical significance of critical radius of insulation and derive an expression for the same critical radius in case of sphere.	**07**
Q.5	**(a)**	Differentiate natural and forced convection.	**03**
	(b)	State the similarities and difference between: 1) Nusselt number and Biot number, 2) Grashof Number and Reynold number.	**04**
	(c)	What is the limitation of Rayleigh's method of dimensional analysis? Which method is preferred in such case and how repeating variables are selected?	**07**

OR

Q.5	**(a)**	Define: Nusselt number, Grashof Number and Reynold number.	**03**
	(b)	State the governing law for convection heat transfer. Explain in brief about convection heat transfer coefficient.	**04**
	(c)	Using Buckingham–π theorem show that, $Nu = f\ (\ Re, Pr)$ for forced convection.	**07**

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