GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2023

Subject Code:3170102   **Date:19-12-2023**

Subject Name: Theory of Heat Transfer

Time: 10:30 AM TO 01:00 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.**
5. **Tables for properties of air and water are permitted.**

Q.1	**(a)**	List down the applications of extended surface with example in day-to-day life.	**03**
	(b)	Explain the different modes of heat transfer in detail.	**04**
	(c)	Derive equations of temperature distribution and heat dissipation for infinite fin.	**07**
Q.2	**(a)**	What do you understand by insulation? Explain critical thickness for cylinder?	**03**
	(b)	Use of aluminum material as a cooking utensils are not desirable. Evaluate	**04**
	(c)	A steel pipe 3 cm in diameter has its outer surface at 200°C, is placed in air at 30°C with heat transfer coefficient of 8.5 W/m^2.K. It is proposed to add insulation (k = 0.07 W/m.K) on its outer surface to reduce the heat loss by 40%. Estimate the thickness of insulation required, if pipe temperature and heat transfer coefficient remain unchanged.	**07**

OR

	(c)	An exterior wall of a house consists of a 0.1 m layer of common brick having thermal conductivity 0.7 W/m.^{0}C. It is followed by a 0.04 m layer of gypsum plaster with thermal conductivity of 0.48 W/m.^{0}C. What thickness of loosely packed rock wool Insulation (k = 0.065 W/m.^{0}C) should be added to reduce the heat loss or (gain) through the wall by 80%?	**07**
Q.3	**(a)**	What is lumped system analysis? What are the assumptions and when is it applicable?	**03**
	(b)	What is meant by thermal resistance? Explain the electrical analogy for solving heat problems	**04**
	(c)	Define Prandtl number. What is the physical interpretation when its value is lesser or greater than one? Show with neat sketches.	**07**

OR

Q.3	**(a)**	Explain the significance of the following terms: (1) Nusselt Number. (2) Grashoff number (3) Reynolds number.	**03**
	(b)	How does the fluid flow inside the duct differ from fluid flow over the bodies?	**04**
	(c)	Derive the momentum equation for hydrodynamic boundary in differential form with neat sketch. Write equation for stretching factor? State its significance for solving momentum equation.	**07**

Q.4 **(a)** Differentiate parallel flow and counter flow heat exchanger. **03**

(b) Write the advantages of the effectiveness-NTU method over the LMTD method. **04**

(c) With a neat sketch explain Film and dropwise condensation. **07**

OR

Q.4 **(a)** State & explain Lambert's cosine law. **03**

(b) Explain the following terms in heat exchanger? **04**
    (1) Effectiveness (2) NTU

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

Q.5 **(a)** What do you mean by fouling factor? State the causes of fouling? **03**

(b) Making use of Plank's law of distribution, establish the relation for the Wien's displacement law. **04**

(c) Derive the Stefan-Boltzmann law from the Plank's law of thermal radiation. What is the value of Stefan-Boltzmann constant? **07**

OR

Q.5 **(a)** What do you understand by absorptivity? How can it be improved for an opaque body? **03**

(b) Define a black body. Give examples of some surfaces which don't appear black but have high value of absorptivity. **04**

(c) Define boiling? Draw boiling curve which shows all the boiling regimes and explain nucleate boiling regime in brief. **07**

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