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

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 2170102 **Date: 02/05/2017**

Subject Name: Theory of 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	**(a)**	Explain briefly the various modes of heat transfer and enumerate the basic laws which govern the heat transfer.	**07**
	(b)	Derive the expression for heat conduction through a composite cylinder with both conduction and convection. Also define overall heat transfer coefficient for the same system arrangement.	**07**
Q.2	**(a)**	Derive the expressions for fin efficiency and fin effectiveness for heat conduction for a fin loosing the heat from the tip.	**07**
	(b)	Explain the dimensionless numbers used in heat transfer with their respective importance in heat transfer.	**07**
		OR	
	(b)	A turbine blade made of stainless steel k= 29W/m°C is 60mm long, 500mm^2 cross sectional area and 120mm perimeter. The temperature of the root of blade is 480°C and it is exposed to products of combustion passing through the turbine at 820°C. If the film coefficient between the blade and the combustion gases is 320 W/m^2°C, calculate: temperature at the middle of the plate and rate of heat flow from the blade.	**07**
Q.3	**(a)**	What is meant by transient heat conduction? Derive the general unsteady state heat conductions equation for solids considering a lump.	**07**
	(b)	Hot air at temperature of 65°C is flowing through a steel pipe of 120mm diameter. The pipe is covered with two layers of different insulating materials of thickness 60mm and 40mm, and their corresponding thermal conductivities are 0.24 and 0.4 W/m°C. The inside and outside heat transfer coefficients are 60 W/m^2°C and 12 W/m^2°C respectively. The atmosphere is at 20°C. Find the rate of heat loss from 60 m length of pipe.	**07**
		OR	
Q.3	**(a)**	Air entering at 2 bar pressure and bulk temperature of 200°C is heated flows through a tube with a diameter of 25.4 mm at a velocity of 10 m/s. calculate the heat transfer per unit length of the tube if constant heat flux condition is maintained at the wall and wall temperature is 20°C above the air temperature all along the length of the tube. At mean film temperature properties of air are 1.493kg/m^3, k = 0.0386W/m°C, $\mu = 2.57\times10^{-5}$ NS/m^2 and Cp = 1025 J/kg°C. Average Nusselt number is given by $Nu = 0.023(R_e)^{0.8}(P_r)^{0.4}$	**07**
	(b)	Classify the types of heat exchanger in detail.	**07**
Q.4	**(a)**	The flow rates of hot and cold water streams running through a parallel flow heat exchanger are 0.2kg/s and 0.5kg/s respectively. The inlet temperatures on the hot and cold sides are 75°C and 20°C respectively. The exit temperature of hot water is 45°C. If the individual heat transfer coefficients on both sides are 650W/m^2°C, calculate overall heat transfer coefficient and the area of the heat exchanger.	**07**
	(b)	Derive the expression for log mean temperature difference for counter flow heat	**07**

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OR

Q.4	**(a)**	16.5 kg/s of the product is at 650°C (C_p = 3.55 kJ/kg°C), in a chemical plant, are to be used to heat 20.5kg/s of incoming fluid from 100°C (Cp = 4.2 kJ/kg°C. If the overall heat transfer coefficient is 950 W/m^2°C and the installed heat transfer surface is 44 m^2, calculate fluid outlet temperatures for the counter flow heat exchanger using Effectiveness-NTU method.	**07**
	(b)	With proper reasons and conditions justify the provision of fins in field applications. Under what circumstances fins may be applicable?	**07**
Q.5	**(a)**	Derive the expression of define radiation heat transfer. State and prove Kircoff's law of radiation.	**07**
	(b)	Define following terms: total emissive power, emissivity, black body, opaque body, white body, grey body and intensity of radiation.	**07**

OR

Q.5	**(a)**	Derive general heat conduction equation in cylindrical coordinates.	**07**
	(b)	Explain the methods of boiling in brief.	**07**

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