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

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 2140403 **Date: 08/06/2017**

Subject Name: Principles of Process Engineering-I

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.**

Q.1		**Short Questions**	**14**
	1	What is Critical radius?	**01**
	2	Give the difference between thermodynamics & Heat transfer.	**01**
	3	Write down Fourier's law of conduction	**01**
	4	Write value of Stefan-Boltzman Constant with proper units.	**01**
	5	What is Emissive Power?	**01**
	6	Define: Transmissivity	**01**
	7	State Kirchhoff's Law of Heat Radiation.	**01**
	8	Give different types of Reciprocating Pumps.	**01**
	9	Value of coefficient of discharge for venturi meter is _____	**01**
	10	Define: a) Ideal Fluid b) Real Fluid c) Bingham Plastic Fluid d) Irrotational Flow e) Reynolds Stress.	**05**
Q.2	**(a)**	Give significance of following dimensionless numbers in case of convection heat transfer (i) Prandlt number (ii) Grashof number (iii) Reynold number	**03**
	(b)	Derive the expression for critical radius in case of Sphere**.**	**04**
	(c)	Calculate the critical radius of insulation for asbestos with k = 0.17 W/mK surrounding a pipe and exposed to room air at 20 ^{o}C with h= 3 W/m^2 K . Calculate the heat loss from a 200 ^{o}C, 50 mm diameter pipe when covered with the critical radius of insulation and without insulation. Would any fiber glass insulation having a thermal conductivity of 0.04 W/mK cause decrease in heat transfer?	**07**
		OR	
	(c)	A furnace wall is made up of steel plate 10 mm thick with inside silica brick lining of 150 mm thick and outside magnesia brick lining of 150 mm. The temperature of inside wall surface is 973 K and outside is 288 K. Calculate the quantity of heat lost in W/m^2. It is required to reduce the heat flow to 1163 W/m^2 by means of air gap between steel plate and magnesia brick. Estimate the width of this gap. Thermal conductivities for steel, silica brick, magnesia brick and air are 16.86, 1.75, 5.23 and 0.033 W/m K respectively.	**07**
Q.3	**(a)**	Explain functions of Baffles.	**03**
	(b)	Explain advantages and disadvantages of single pass and multi pass heat exchangers.	**04**
	(c)	Derive equation for LMTD for heat exchangers.	**07**
		OR	
Q.3	**(a)**	Discuss in brief the three modes of Heat transfer.	**03**
	(b)	Derive Kirchhoff's Law for heat radiation.	**04**
	(c)	Derive Bernoulli's equation stating the assumptions and limitations involved in it.	**07**

Q.4	**(a)**	Explain in brief wave theory of radiation.	**03**
	(b)	Derive the governing equation for unsteady state heat conduction.	**04**
	(c)	Explain Buckingham-π method of dimensional analysis with any one example.	**07**

OR

Q.4	**(a)**	Explain different types of flow patterns in heat exchangers.	**03**
	(b)	Derive an expression for steady state heat conduction through a composite cylinder of three layers.	**04**
	(c)	Crude oil flows at the rate of 1000 kg/hr through the inside pipe of a double pipe heat exchanger and is heated from 30 ºC to 90ºC. The heat is supplied by Kerosene initially at 200 ºC flowing through the annular space. If the temperature difference (approach) is 10ºC, determine the heat transfer area for co-current flow and the kerosene flow rate. Cp for Crude oil = 0.5 kcal/kgºC Cp for Kerosene = 0.6 kcal/kgºC U_0 = 400 kcal/hr $m^{2o}C$	**07**
Q.5	**(a)**	Explain Drag force.	**03**
	(b)	Differentiate between Laminar and Turbulent flow.	**04**
	(c)	Calculate the power to pump a liquid at the rate of 1.5 kg/s from a ground level tank at atmospheric pressure through a 50mm ID steel pipe to an overhead tank 3m above at 2 kg/cm^2 pressure. The distance between two tanks is 500m. Efficiency of the pump is 70%. The density and viscosity of the liquid is $1500kg/m^3$ and 20 cp respectively. Friction factor f =16/Re	**07**

OR

Q.5	**(a)**	Explain principle of hydrostatic equilibrium	**03**
	(b)	Explain concept of U-tube manometer, and derive expression for ΔP in U-tube manometer.	**04**
	(c)	Describe Reynolds experiment in brief .Water of density 1 gm/cc and viscosity 1cp is flowing in a pipe of 25mm ID at the rate of 1000 kg/min. Calculate the Reynolds number and find the type of flow.	**07**

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