Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(New) EXAMINATION – SUMMER 2016

Subject Code:2140403 **Date:06/06/2016**

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.**

			MARKS
Q.1		**Short Questions**	**14**
	1	Give Significance of a) Nusselt number b) Peclet number	**01**
	2	Define :Thermal Conductivity	**01**
	3	State the basic law of Heat Radiation.	**01**
	4	Define: a) Emissivity b) Gray body c) Opaque body	**03**
	5	Write different units of pressure (at least three)	**01**
	6	What is drag coefficient?	**01**
	7	Give any one example of head meter for flow measurement.	**01**
	8	Give significance of Reynolds number	**01**
	9	Define: a) Potential Flow b) Newtonian Fluid c) Stream line flow	**03**
Q.2	**(a)**	Differentiate between Natural Convection and Forced Convection with suitable examples.	**03**
	(b)	Derive the expression for critical radius in case of Sphere**.**	**04**
	(c)	Differentiate between Conduction, convection and radiation with examples, mechanisms and laws of each in detail.	**07**
		OR	
	(c)	Derive equation for heat transfer rate per unit length of cylinder for steady state simultaneous heat conduction and convection through cylindrical wall.	**07**
Q.3	**(a)**	Write equation for LMTD in case of heat exchanger and give its significance.	**03**
	(b)	Explain the concept of black body and its characteristics in brief.	**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 Crude Kerosene = 0.6 kcal/kgºC U_0 = 400 kcal/hrm^{2o}C	**07**
		OR	
Q.3	**(a)**	Derive an expression for steady state heat conduction through a composite cylinder of three layers.	**03**
	(b)	Explain in details quantum theory of radiation.	**04**
	(c)	Water flows through a pipe AB of 1.2m diameter at 3m/s and then passes through a pipe BC of 1.5m diameter. At C, the pipe branches. Branch CD is 0.8m diameter and carries one third of the flow in AB. The flow velocity in branch CE is 2.5m/s. Find the volumetric flow rate of the flow in pipe AB, velocity in pipe BC and CD. Also find the diameter of pipe CE.	**07**

Q.4	**(a)**	Explain different types of flow patterns in heat exchangers with diagram.	**03**
	(b)	Calculate the critical radius of insulation for asbestos with K=0.17 W/m K 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?	**04**
	(c)	Derive Bernoulli's equation stating the assumptions and limitations involved in it.	**07**

OR

Q.4	**(a)**	Compare fixed tube heat exchanger with floating head heat exchanger.	**03**
	(b)	A furnace is constructed with 229 mm thick of fire brick, 115mm of insulation brick and again 229 mm of building brick. The inside temperature is 1223K and the temperature at the outermost wall is 323K. Thermal Conductivities of fire brick, insulating brick and building brick are 6.05, 0.581,and 2.33 W/mK.Find the heat loss per unit area and temperatures at the interfaces	**04**
	(c)	State different laws of black body radiation and derive the expression of Wein's displacement law using Planck's law	**07**
Q.5	**(a)**	Explain cavitation and priming in pumps.	**03**
	(b)	Explain concept of boundary layer in details.	**04**
	(c)	A pump draws a solution with specific gravity 1.84 from a storage tank through 75mm pipe. The efficiency is 60% while the velocity in the suction line is 0.914m/s. The pump discharges through a 50mm pipe to an overhead tank at a level of 15.2m. The total frictional loss in the pipe is 29.9J/kg. Calculate the total power input and total pressure developed by the pump.	**07**

OR

Q.5	**(a)**	Give types of fluidization.	**03**
	(b)	Discuss classification of fluids.	**04**
	(c)	Explain Buckingham –π theorem of dimensional analysis giving an example.	**07**

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