Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER-1 (NEW) EXAMINATION – WINTER 2016

Subject Code: 2713009 **Date:05/01/2017**

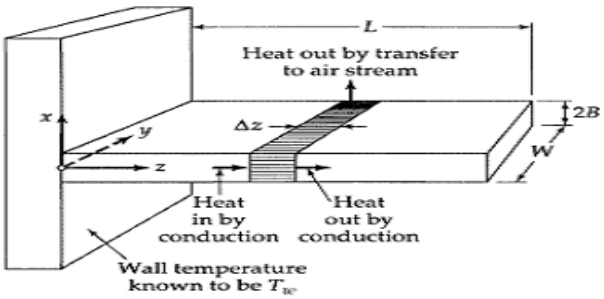
Subject Name: Advanced Transport Processes

Time: 2:30 pm to 5:00 pm **Total Marks: 70**

Instructions:

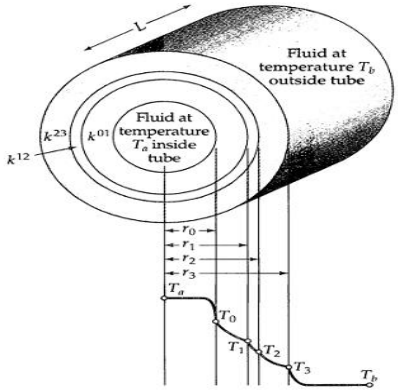
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Notations used have their conventional meanings.**

Q.1		Using concept of Universal Velocity Profile, derive mathematical expression of Vankarman's analogy in a fully developed flow through a pipe. State all the assumptions made.	**14**
Q.2	**(a)**	Derive the rate expression of molecular diffusion of gases through porous media.	**07**
	(b)	What is Rheology? Classify the fluids on the basis of Rheology along with examples.	**07**
		OR	
	(b)	Derive Shell Momentum Balances and velocity profile equation for flow through annulus.	**07**
Q.3	**(a)**	Derive Navier-Stoke's equation in Cylindrical Coordinate for momentum transfer.	**07**
	(b)	Write a short note on heat transfer with phase change.	**07**
		OR	
Q.3	**(a)**	Explain fundamentals of boundary layer flow and turbulence.	**07**
	(b)	Derive governing equation for unsteady state heat conduction.	**07**
Q.4		Derive an expression of temperature profile for heat conduction in a cooling fin with wall temperature is Tw and ambient temperature Ta. List the assumptions made in deriving expression. Also determine expression for effectiveness of fin.	**14**



OR

Q.4		Derive an expression for temperature profile in case of steady state heat conduction through solid composite cylinder with diagram Shown below.	**14**



Q.5 **(a)** Write a note on diffusion with chemical reaction. **07**

(b) Derive the equation of continuity for multi component mixture in case of mass transfer. **07**

OR

Q.5 **(a)** Explain shell mass balance and boundary conditions used in mass transfer. **07**

(b) The concentration of undesirable impurity in air (at 1 bar = 10^5 Pa) is to be reduced from 0.1% (or 100 Pa) to 0.02% (or 20 Pa) by absorption in pure water. Find the height of tower required for countercurrent operations. **07**

Data:

For the packing: $K_{Ag}a = 0.32$ mol/hr.m^3.Pa, $K_{Al}a = 0.1$/hr

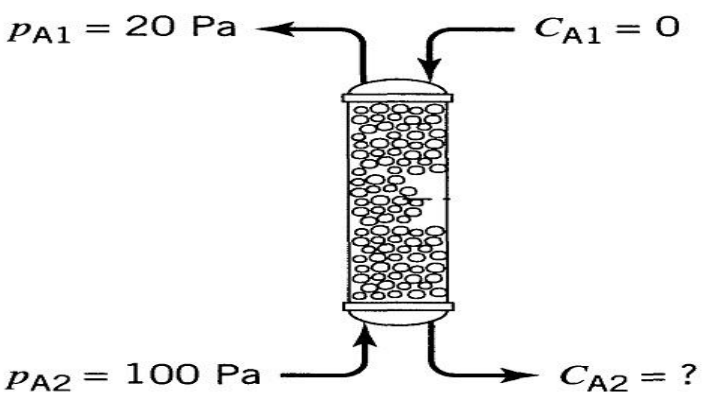
The solubility of A in water is given by Henry's law constant

$H_A = p_{Ai}/C_{Ai} = 12.5$ Pa. m^3/mol

The flow rates per meter square cross section of tower are

$F_g/A_{cs} = 1x\ 10^5$mol/hr.m^2, $F_l/A_{cs} = 7\ X\ l0^5$ mol/hr.m^2

The molar density of liquid under all conditions is $C_T = 56{,}000$ mol/m^3



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