Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER • 2014

Subject code: 2713009 **Date: 09-01-2015**

Subject Name: Advanced Transport Processes

Time: 02:30 pm - 05:00 pm **Total Marks: 70**

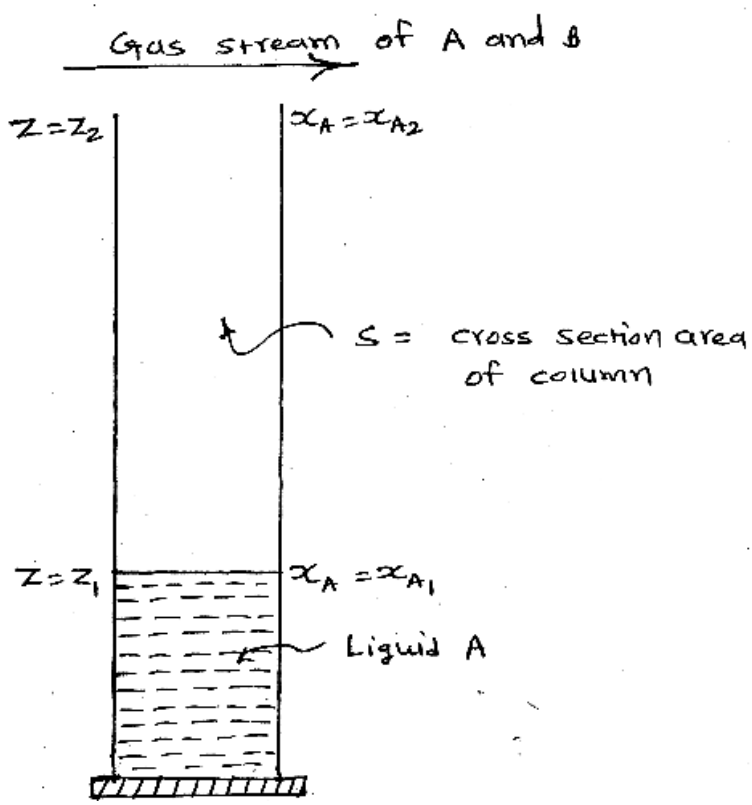
Instructions:

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

Q.1	**(a)**	What are different analogies found in simultaneous momentum and heat transfer? State its applications. Also, derive mathematical statement of Prandtl-Taylor analogy in a fully developed flow through a pipe. State all the assumptions made.	**08**
	(b)	Derive governing equation for unsteady state heat conduction.	**06**
Q.2	**(a)**	Explain the general procedure of shell energy balance and also mention the commonest type of boundary conditions in case of energy transport.	**07**
	(b)	Water is flowing through a 2.5 cm i.d. and 10 m long pipe at a rate of 5 m/s. the inlet temperature of water is 25^0C and pipe walls are kept at 65^0C. Calculate rise in temperature of water for the following cases: (i) Reynoldôs analogy (ii) Prandtl-Taylor analogy Data : ɟ = 10^3 kg/m^3, ε = 10^{-3} Pa.s, C_p = 4.1 kJ/kg K, k = 0.6 W/m K, f = 0.046 $Re^{-0.2}$	**07**
		OR	
	(b)	Why fins are used in heat transfer? Stating all relevant assumptions, derive the equation for temperature distribution across the rectangular cooling fin.	**07**
Q.3	**(a)**	Classify Non ï Newtonian fluids based on time dependent and time independent shear stress. Also state example of each type of fluid.	**07**
	(b)	Discuss and derive the equation of continuity of momentum transfer and state physical significance of it.	**07**
		OR	
Q.3	**(a)**	Starting with all assumptions made, derive an equation for the radial velocity distribution for a Newtonian fluid flowing through a circular pipe of radius óRô and length óLô. Also derive the equation for maximum velocity at the centre of pipe.	**07**
	(b)	Define and discuss various types of time derivatives used in the equation of change for momentum transfer.	**07**
Q.4	**(a)**	Derive an equation for temperature distribution for fully developed viscous flow in case of steady state heat transfer.	**07**
	(b)	Explain universal velocity distribution in turbulent flow.	**07**
		OR	
Q.4	**(a)**	Derive an expression for the coefficient of film condensation for vertical tubes. Also state assumptions made.	**07**

Q.4 **(b)** A large volume of pure gas B at 2 atm pressure is flowing over a surface from which pure A is vaporizing. The liquid A completely wets the surface, which is a blotting paper. Hence, the partial pressure of A at the surface is the vapor pressure of A at 298 K, which is 0.20 atm. The $k^{\hat{0}}_y$ has been estimated to be 6.78×10^{-5} kg mol/s.m^2.mol frac. Calculate N_A, the vaporization rate, and also the value of k_y and k_G. **07**

Q.5 **(a)** Consider the diffusion system as shown in below figure. Liquid A is evaporating into gas B. A and B forms an ideal gas mixture and the solubility of B in liquid A is negligible. Derive an expression for concentration profile of A in z-direction. **08**



(b) Write a note on diffusion with chemical reaction. **06**

OR

Q.5 **(a)** Derive the equation of continuity for multi component mixture in case of mass transfer. **07**

(b) Write a note on diffusion of gases in porous media. **07**

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