Code No: **R41081** **R10** **Set No. 1**

IV B.Tech I Semester Supplementary Examinations, February/March - 2018

TRANSPORT PHENOMENA

(Common to Chemical Engineering and Petroleum Engineering)

Time : 3 hours **Max. Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks
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1 a) Write a note on Eyring theory of viscosity of liquids. [4]
b) Define the terms convective mass flux and molecular mass flux. [4]
c) Define momentum flux and determine the same, when the lower plate velocity is 2ft/s in the positive z-direction. The plate separation is 0.002 ft and the fluid viscosity is 0.7 cp. [7]

2 a) Derive the expression for velocity and momentum balance distribution for the upward flow in a cylindrical annulus. [8]
b) A power law fluid flows through a circular pipe in a laminar flow under a pressure gradient. Derive the equation for momentum flux and velocity distribution. [7]

3 a) Compare and contrast forced and free convection heat transfer. [5]
b) Heat flows through an annular wall of inside radius R_o and outside radius R_1. The thermal conductivity of the wall varies linearly with the temperature from k_o at T_o to k_1 at T_1. Derive an expression for heat flow through the wall using shell energy balance. [10]

4 a) Define Thiele modulus and diffusion controlled reaction. [3]
b) Consider a simple model for a catalytic reactor, in which a reaction $2A \rightarrow B$ is being carried out. Assume that each catalyst particle is surrounded by a stagnant gas film through which A has to diffuse to each the catalyst surface. At the catalyst surface assume that the reaction $2A \rightarrow B$ occurs instantaneously, and that the product B then diffuses back out through the gas film to the main turbulent stream containing A and B. [12]

5 a) Explain substantial derivative with the help of an example. [3]
b) Equation of motion is a 'statement of Newton's second law of motion'. Prove the statement from the first principles of writing conservation of momentum balance for a fluid flowing in random direction through a volume element of size $\nabla x \nabla y \nabla z$. [12]

6 A fluid whose viscosity is to be measured is placed in the gap of thickness B between the two disks of radius R. The upper disk is rotated with a torque τ at an angular velocity of Ω. Develop the formula for the calculation of viscosity. Use equation of motion to solve the problem. [15]

7 A semi-infinite slab occupying space from $y = 0$ to $y = \alpha$ is initially at temperature T_o. At time $t = 0$, the surface at $y = 0$ is suddenly raised to T_α and maintained at that temperature. Derive the equations for (a) temperature distribution (b) thermal boundary layer (c) heat flux at $y = 0$. [15]

8 a) What is time smoothing? Explain and give its significance. [9]
b) Write a note on Prandtl mixing length theory. [6]