

MECM-102

M. E./M. Tech. (First Semester)

EXAMINATION, Dec., 2011

(Grading/Non-Grading System)

(Chemical Engg. Branch)

ADVANCED TRANSPORT PHENOMENON

(MECM-102)

Time : Three Hours

Maximum Marks : $\begin{cases} GS : 70 \\ NGS : 100 \end{cases}$

Note : Attempt any four questions. All questions carry equal marks.

- ✓ 1. Develop the equation of motion in the form which states that a small volume element moving with the fluid is accelerated because of the forces acting upon it :

$$\rho \frac{\Delta v}{\Delta t} = -\nabla P - [\nabla \cdot \tau] + \rho g$$

- ✓ 2. Determine the velocity and stress distribution for the flow of a Bingham plastic fluid between two vertical coaxial cylinders, the outer one of which is rotating with an angular velocity Ω_0 . End effects may be neglected.
- ✓ 3. Find the time smoothed velocity distribution for turbulent flow in a long tube using the Prandtl mixing length relation. The radius and length of the tube are R and L.

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4. Explain the friction factors for packed columns and obtain an expression for superficial velocity.
- ✓ 5. How are the energy equation, the equation of mechanical energy and the equation of thermal energy related ?
A flat plate heated to a temperature T_0 is suspended in a large body of fluid, which is at temperature T_1 . In the neighborhood of the heated plate the fluid rises because of buoyancy force. From the equation of change deduce the dependence of the heat loss on the system variables. The physical properties of the fluid may be considered constant, except that the free convection form of the equation of motion should be used.
6. Define Soret coefficient. What are its units ? What are the mass transfer analogs of the Grashof and Prandtl numbers ?