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Roll No

CM-702(A)-CBGS

B.Tech., VII Semester

Examination, December 2020

Choice Based Grading System (CBGS)

Transport Phenomena

Time : Three Hours

Maximum Marks : 70

- Note:** i) Attempt any four questions.
ii) All questions carry equal marks.
iii) Draw neat sketch and assume suitable data wherever you required.

1. a) What is transport phenomena? Write the Newton's law of viscosity, Fourier's law of heat conduction and Fick's law of diffusivity and explain why these three laws can be considered analogous.
b) What is the diffusivity for a dilute solution of acetic acid in water at 12.5°C. The density of acetic acid at its normal boiling point is 0.937 g/cm³. The viscosity of water at 12.5°C is 1.22 cP. Using the Wilke-Chang equation.
2. a) Write short notes on Boundary conditions, their significance, importance and selection.
b) Assume that two fluids are flowing simultaneously between two broad parallel flat plates. The system is adjusted so that each fluid fills half of the space between the plates. Fluid A (more dense) has a viscosity of μ_A and fluid B's viscosity is μ_B . Find the velocity distribution under a pressure drop of $P_L - P_o$. Also determine the shear stress profile.

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3. a) By making a mass balance over a volume element $(\Delta r)(r\Delta\theta)(\Delta z)$ derive the equation of continuity in cylindrical coordinates.
b) Determine the velocity and shear stress distribution for the tangential laminar flow of an incompressible fluid between two vertical coaxial cylinders, the outer one of which is rotating with angular velocity Ω . End effects may be neglected.
4. a) Explain shell energy balance approach.
b) Find the temperature profile for the laminar flow of a Newtonian fluid (constant density and thermal conductivity) if there is a constant energy flux at the wall.
5. a) A droplet of material C (radius r_1) is suspended in a gas stream of D which forms a stagnant film around the droplet (radius r_2). If the C concentrations are X_{c_1} and X_{c_2} at r_1 and r_2 , find the flux of C. Let D_{CD} be the diffusion coefficient.
b) A gas A contacts a static liquid B in a tall vertical container. When the gas A diffuses, it also reacts (irreversible first-order reaction). Find the concentration profile of A in the liquid as well as its molar flux.
6. a) Explain the fully developed, time-smoothed velocity distribution in the neighborhood of a wall.
b) Compare the velocity distribution and average velocity For the steady, fully developed laminar and turbulent flow in a circular tube of radius R.
7. a) Write Macroscopic Momentum Balance and Calculate the force on a reducing bend.

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- b) Two tanks containing water are connected with a horizontal pipe 0.075 m in diameter and 300 m long. The bottoms of both tanks are at the same level. Tank A is 7 m in diameter and has a depth of 7 m. Tank B (5 m in diameter) has a depth of 3 m. How long will it take for the liquid level in Tank A to fall to 6 m?
