

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

First Semester 2022-2023

CHE F414 Transport Phenomena

Mid Semester Exam (Closed Book)

Date: 02.11.2022, 2-3:30 PM

Duration: 90 Min.

Total Marks: 30

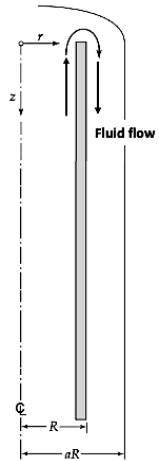
- State and justify any assumptions that you make. Nomenclature should be defined properly.

- Q.1** (A) Compute the steady-state momentum flux τ_{yx} in Pascal when the lower plate velocity is 0.25 m/s in the positive x-direction, the plate separation is 0.025 cm, and the fluid viscosity is 0.5 cp.
 (B) Water at 20°C flows down a vertical wall with $Re = 10$. Calculate the film thickness in mm. The kinetic viscosity of water at 20°C is $1.0 \times 10^{-2} \text{ cm}^2/\text{s}$.
 (C) Explain the interpretation of π_{ij} . Compare the molecular and convective mechanisms of momentum transport.
 (D) Write different boundary conditions for solving governing equations of momentum transport.
 (E) Compare the velocity profiles in a circular tube under Laminar and Turbulent flow conditions.
[2+2+1+1+1=7 M]

- Q.2** Develop Prandtl Boundary layer equations using order-of-magnitude analysis. **[5 M]**

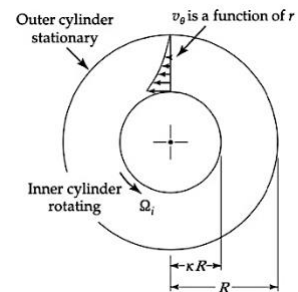
- Q.3** In a gas absorption experiment, viscous fluid flows upward through a small circular tube and then downward in laminar flow on the outside. Using the shell momentum balance method, Determine the following:
 (a) Velocity distribution in the falling film
 (b) Obtain an expression for the mass flow rate in the film

[6+2 = 8 M]



- Q.4** A liquid is in the annular space between two vertical cylinders of radii kR and R , respectively. The liquid is open to the atmosphere at the top. The inner cylinder rotates at an angular velocity of Ω_i , and the outer cylinder is stationary. Using the equation of motion,
 (a) Determine the velocity distribution in the fluid, and
 (b) Determine the shape of the free liquid surface.

[6+4 = 10 M]



~ALL THE BEST~