

KATHMANDU UNIVERSITY  
End Semester Examination  
February/March, 2019

FEB 25 2019

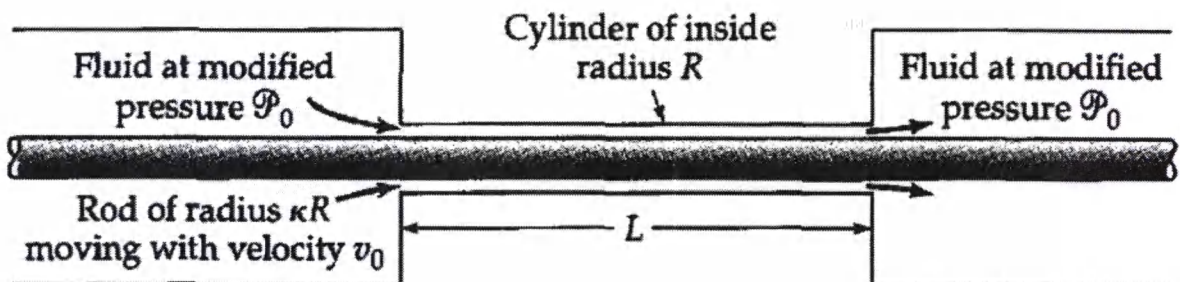
Level : B.E.  
Year : IV  
Time : 2 hrs. 30 mins.

Course : CHEG 401  
Semester : I  
F.M. : 40

SECTION "B"

Attempt *ALL* questions.

1. Derive equation of continuity in Cartesian and Cylindrical co-ordinate.  
OR  
Discuss partial, total and substantial time derivatives. [6]
2. Derive expression for Hagen–Poiseuille equation using shear stress as momentum flux.  
OR  
Derive the expression for the velocity profile and maximum velocity of falling film outside the circular tube. [6]
3. Derive the Navier stokes equation. Determine the mass flow rate for radial flow between two parallel discs.  
OR  
What do you mean by non-Newtonian fluids? Discuss various models which are used for the determination of rate of shear for non-Newtonian fluids. [6]
4. A cylindrical rod of diameter  $\kappa R$  moves axially with velocity  $v_0$  along the axis of a cylindrical cavity of radius  $R$  as seen in figure. The pressure at both ends of the cavity is the same, so that ends of the cavity is the same, so that the fluid moves through the annular region solely because of the rod motion.

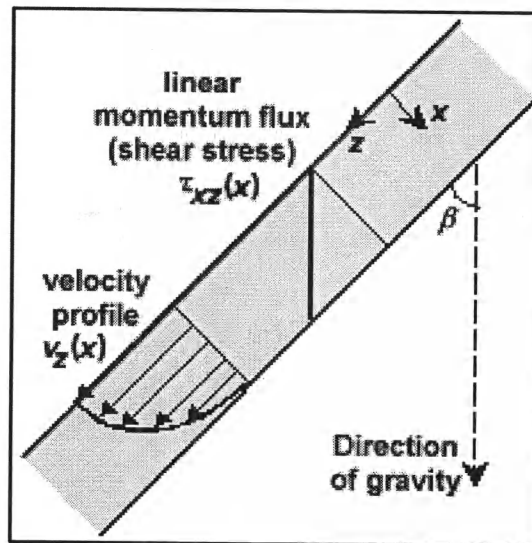


- a. Find the velocity distribution in annular region.
- b. Find the mass flow rate of flow through the annular region

OR

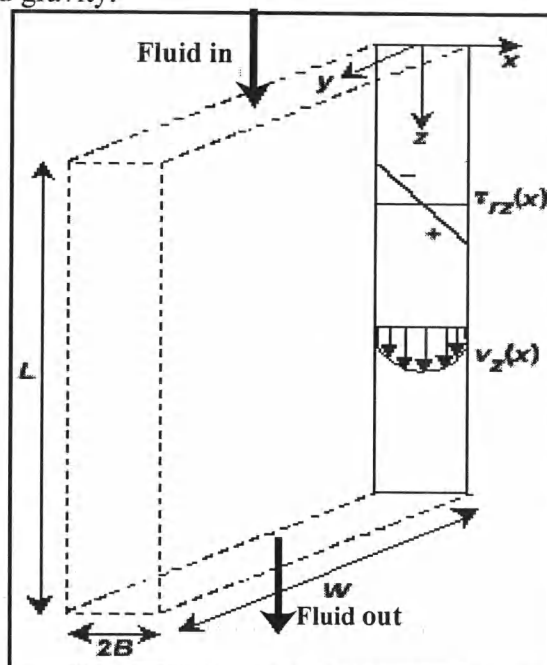
Consider a Newtonian liquid (of viscosity  $\mu$  and density  $\rho$ ) in laminar flow down an inclined flat plate of length  $L$  and width  $W$ . The liquid flows as a falling film with

negligible rippling under the influence of gravity. End effects may be neglected because  $L$  and  $W$  are large compared to the film thickness  $\delta$ .



Determine the steady-state velocity distribution and obtain the mass rate of flow and average velocity in the falling film. [6]

5. Consider a fluid (of density  $\rho$ ) in incompressible, laminar flow in a plane narrow slit of length  $L$  and width  $W$  formed by two flat parallel walls that are a distance  $2B$  apart. End effects may be neglected because  $B \ll W \ll L$ . The fluid flows under the influence of both a pressure difference  $\Delta p$  and gravity.



Using a differential shell momentum balance, determine expressions for the steady-state shear stress distribution and the velocity profile for a Newtonian fluid (of viscosity  $\mu$ ).

OR

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Derive the expression for the torque of coquette flow when fluid is non-Newtonian in nature and having property of Power law fluid or Bingham fluid. [6]

6. Write a note on

[2 × 5=10]

- (a) Dynamic and kinematic viscosity
- (b) Importance of co-ordinate system
- (c) Unsteady state and pseudo-steady state
- (d) Convective momentum flux and molecular momentum flux
- (e) Laminar and turbulent flow

