

Code: 13A01303

B.Tech II Year I Semester (R13) Regular &amp; Supplementary Examinations December 2015

**FLUID MECHANICS**  
(Civil Engineering)

Time: 3 hours

Max. Marks: 70

**PART – A**  
(Compulsory Question)

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- 1 Answer the following: (10 X 02 = 20 Marks)
- Define viscosity and state the reason for variation in behavior of viscosity of gases and liquids w.r.t temperature.
  - Distinguish between static pressure and total pressure.
  - State the stability criteria for a submerged body in unstable and neutral equilibrium positions.
  - Distinguish between uniform and non-uniform flow.
  - What does Hydraulic gradient line represent?
  - What is a mouth piece?
  - Name the forces considered in deriving the momentum equation.
  - Why the triangular weir is more suitable than a rectangular weir for discharge measurement?
  - Distinguish between minor and major losses in pipe flow.
  - What do you understand by the term "Mixing length"?

**PART – B**  
(Answer all five units, 5 X 10 = 50 Marks)**UNIT – I**

- 2 (a) Derive the formula for capillary rise of a fluid in the annulus of two concentric glass tubes of radii  $R_o$  and  $R_i$  respectively.
- (b) A flat plate of area  $0.5 \text{ m}^2$  moves through oil between two large fixed parallel planes 8 cm apart. If the velocity of the plate is 0.5 m/sec and the oil has specific gravity 0.8 and kinematic viscosity of  $0.45 \times 10^{-4} \text{ m}^2/\text{sec}$ , calculate the drag force acting on the fluid. Assume the plate is parallel and is equidistant from both the planes.

**OR**

- 3 (a) State the hydrostatic law for an incompressible fluid.
- (b) Determine the magnitude and direction of the resultant force acting on a cylindrical roller gate of 2.5 m diameter and length 5 m due to the water when the gate is placed on the dam such that water is just going to spill over it.

**UNIT – II**

- 4 (a) Explain the terms: (i) Center of buoyancy. (ii) Meta-center. (iii) Center of gravity.
- (b) A rectangular box of  $24 \text{ m}^2$  cross sectional area and 2 m height having a weight of 400 kN is immersed in freshwater of density  $1000 \text{ kg/m}^3$ , calculate the depth of immersion of box.
- OR**
- 5 (a) Define stream function and velocity potential and express the condition for irrotational flow in terms of stream function and velocity potential.
- (b) In a steady two dimensional incompressible flow, the velocity component in the X direction is  $u = 4x^2 + y^2$ . Find the velocity component 'v' in Y direction. Assume at  $Y = 0$ ,  $v = 0$ . Also find the direction of the stream line with respect to X axis at a point (2, 2).

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## UNIT – III

- 6 (a) What is free vertex flow? Give some practical examples of its occurrence.  
 (b) A 20 cm diameter pipe carries water under a head of 20 m with a velocity of 3.5 m/sec. If the axis of the pipe turns through  $30^\circ$ , determine the magnitude and direction of the resultant force on the bend.

OR

- 7 (a) With a neat sketch, explain the venturimeter principle and derive an expression for discharge through it.  
 (b) A venturimeter of 0.6 contraction ratio is fitted to a 100 mm diameter horizontal pipe. The head of water on the meter under no flow condition is 3 m gauge. Find the rate of flow when the throat pressure is 2 m of water absolute. Assume coefficient of discharge for venturimeter as 0.98.

## UNIT – IV

- 8 (a) Distinguish between free and submerged orifice.  
 (b) An orifice of 10 cm diameter under a head of 3 m discharges 35 liters per second of water. The jet from the orifice exerts a force of 300 N on a flat plate placed normal to it. Determine the theoretical discharge, coefficient of velocity and coefficient of contraction.

OR

- 9 (a) What do you understand by Aeration of Nappe and why is it required?  
 (b) Water flows through a rectangular channel 1 m wide and 0.5 m deep and then over a Cipolletti weir of crest length 60 cm. If the water level in the channel is 22.5 cm above the weir crest, calculate the discharge over the weir: (i) Neglecting the velocity of approach. (ii) Considering the velocity of the approach. Take  $C_d = 0.6$  and assume angle of inclination for Cipolletti weir as  $\tan^{-1}(\frac{1}{4})$ .

## UNIT – V

- 10 (a) Show that in a laminar flow through pipe the average velocity occurs at  $0.707R$  from the center of the pipe of radius  $R$  if velocity distribution across the pipe is given by  $U = \frac{1}{4\mu} \left( \frac{-dp}{dx} \right) (R^2 - r^2)$   
 (b) Water is flowing through a 25 cm diameter pipe with friction factor  $f = 0.04$ . A shear stress at a point 5 cm from the pipe axis is 125Pa. calculate the shear stress at the pipe wall assuming the variation of velocity across the pipe follows  $U = \frac{1}{4\mu} \left( \frac{-dp}{dx} \right) (R^2 - r^2)$

OR

- 11 (a) Derive an expression for head loss due to sudden enlargement in a pipe flow.  
 (b) At sudden enlargement of water line from 25 cm to 50 cm diameter pipe, the hydraulic gradient raises by 1 cm, calculate the rate of flow.

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