Code: 13A01303

R13

B.Tech II Year I Semester (R13) Regular & 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)

(a) Define viscosity and state the reason for variation in behavior of viscosity of gases and liquids w.r.t temperature.

(b) Distinguish between static pressure and total pressure.

(c) State the stability criteria for a submerged body in unstable and neutral equilibrium positions.

(d) Distinguish between uniform and non-uniform flow.

(e) What does Hydraulic gradient line represent?

(f) What is a mouth piece?

(g) Name the forces considered in deriving the momentum equation.

(h) Why the triangular weir is more suitable than a rectangular weir for discharge measurement?

(i) Distinguish between minor and major losses in pipe flow.

(j) 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_0 and R_i respectively.

(b) A flat plate of area 0.5 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 x 10^{-4} m^2/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 m^2 cross sectional area and 2 m height having a weight of 400 kN is immersed in freshwater of density 1000 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).

Contd. in page 2

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^o, 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 $U = \frac{1}{4\mu}\left(\frac{-dp}{dx}\right)\left(R^2 - r^2\right)$

(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 $U = \frac{1}{4\mu}\left(\frac{-dp}{dx}\right)\left(R^2 - r^2\right)$

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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