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| Printed pages:4 | AG302 |
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B TECH
(SEM III) THEORY EXAMINATION 2014-15
FLUID MECHANICS

TIME: 3 Hours

Total Marks: 100

Note: (i) Attempt all the questions. Each question carries equal marks.
(ii) Be precise in your answer.

Section (A)

Q1. Attempt all the questions. 2x10=20

- a. What is kinematic viscosity? State & explain Newton's law of viscosity.
- b. Explain how vacuum pressure can be measured with the help of U- tube manometer.
- c. Explain the stability of a floating body (fully submerged in the fluid).
- d. Calculate the velocity components of u & v of a 2-D flow system described by the stream function, $\psi = x^2 - y^2$.
- e. Explain the principle of rotameter.
- f. A jet of water issues from a sharp edge vertical orifice under a constant head of 0.51 m. at a certain point of issuing jet, the vertical and horizontal coordinates measured from vena-contracta are 0.406 m and 0.085 m respectively. Determine c_c , c_v and c_d .
- g. A right angled triangular notch is provided in the vertical side of a tank having plane area of 0.93 m^2 uniform at all levels. When the head over the notch is 75 mm, it is found that the water surface in the

- tank is falling down at a rate of 2.25 mm/s, calculate c_d .
- h. Distinguish between Darcy's friction factor and Manning's friction factor.
 - i. Define stream line, streak line and Path line.
 - j. What do you understand by TGL and HGL?

Section (B)

Q2. Attempt any three questions. 10x3=30

- a. If the equation of a velocity profile over a plate is $U=2.3y+5$; in which U is velocity in m/s at a distance y m above the plate. Determine the shear stress at $y=0$ and $y=0.075$ m, where dynamic viscosity of the oil is 8.35. Write down the infeasibility in the question.
- b. Derive the continuity equation for 3-D steady irrotational flow for incompressible fluid.
- c. Explain:
 - (i) Ventilation of weir
 - (ii) Cipolletti notch
 - (iii) Broad crested weir
 - (iv) Submerged weir
- d. For the distribution main of a city water supply a 0.30 m main is required. As pipe sizes above 0.250 m are not available, it is decided to lay two parallel mains of same diameter. Find the diameter of parallel main.
- e. What is the physical significance of Reynolds number and Froude number in the theory of similarity?

Section (C)

Q3. Attempt any two parts from the following. 5x2=10

- a. A wooden cylinder (specific gravity = 0.6) of circular cross section having length and diameter d floats in water. Find the maximum permissible l/d ratio so that the cylinder may float in stable equilibrium with its axis vertical.

b. A circular opening, 3 m in diameter, in the vertical side of a water tank is closed by a disc of 3m diameter, which can rotate about a horizontal diameter. Calculate

- (i) the force on the disc
- (ii) torque required to maintain the disc in the vertical position when the head of water above the horizontal diameter is 4 m.

c. Deduce the expression for the force and its position on a vertical plane submerged surface.

Q4. Attempt any two parts from the following. $5 \times 2 = 10$

- a. What is the irrotational velocity field associated with the potential function? Does this equation satisfy the incompressible continuity equation?
- b. What do you understand by flow net and where are these applied.
- c. Define rotation, circulation, uniform flow and irrotational flow.

Q5. Attempt any two parts from the following. $5 \times 2 = 10$

- a. Derive the expression for the Bernaulli's Equation from Euler's equation along a streamline.
- b. Explain the working of Venturimeter with a neat sketch and find the expression for discharge.
- c. A fireman holds a water hose ending into a nozzle that issues a 20 mm diameter jet of water. If the pressure of water in the 60 mm diameter hose is 700 kPa, find the force experienced by the fireman.

Q6. Attempt any two parts from the following. $5 \times 2 = 10$

- a. State Buckingham's theorem.
- b. A ship has a length of 150 m and wetted area of 3000 m^2 . A model for this ship 5 m in length when

towed in fresh water ($\rho = 1000 \text{ kg/m}^3$) at 2 m/s produces a resistance of 40 N. Calculate:

- (i) the corresponding speed of the ship.
 - (ii) the shaft power required to propel the ship at this speed through sea water ($\rho = 1030 \text{ kg/m}^3$). Take the propel efficiency as 75%.
- c. Explain, what are the minor losses in a pipe flow? Under what circumstances will they be negligible?

Q7. Attempt any two parts from the following. $5 \times 2 = 10$

- a. A 5 cm diameter pipe takes off abruptly from a large tank and runs 8 m, then changes abruptly to 10 cm diameter and runs 45 m, and next discharges directly into the open air with a velocity of 1.5 m/s. compute the necessary height of water surface above the point of discharge. Take friction coefficient $f = 0.0065$ in the Darcy equation.
- b. At sudden enlargement of waterline from 24 cm to 48 cm diameter pipe, the hydraulic gradient rises by 1 cm. calculate the rate of flow.
- c. Find out the most economical section for the trapezoidal section