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(Following Paper ID and Roll No. to be filled in your Answer Book)

Paper ID :100301 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. III) THEORY EXAMINATION, 2015-16

FLUID MECHANICS

[Time:3 hours] **[MaximumMarks:100**

Section-A

Q.1 **Attempt all parts. All parts carry equal marks. Write answer of each part in short.** (2×10=20)

(a) Write down the definitions of gauge pressure and absolute pressure?

(b) Explain metacentre and metacentric height.

(c) What do you understand by buoyant force?

(d) Differentiate between steady and unsteady flow.

(e) Write down the definition of stream function.

(f) What do you understand by circulation?

(g) What do you understand by kinetic energy correction factor?

(h) What is the meaning of geometric similarity between model and prototype?

(i) What do you understand by TEL and HGL?

(j) What do you understand by displacement thickness?

Section-B

Note: Attempt <u>any five</u> questions from this section.

$10 \times 5 = 50$

Q2. What should be the diameter of a droplet of water, if the pressure inside is to be 0.0018 kg(f)/cm^2 greater than the outside? Given the value of surface tension of water in contact with air at 20°C as 0.0075kg(f)/m.

Q3. A 3.6 m by 1.5 m wide rectangular gate is vertical and is hinged at point 0.5 m below the centre of gravity of the gate. The total depth of water is 6 m. What horizontal force must be applied at the bottom of the gate to keep the gate closed?

Q4. A U-tube having its vertical legs 0.6 m apart is partially filled with carbon tertachloride (specific gravity 1.6) and rotated about a vertical axis 0.15 m. from one leg. What will bi the difference in elevation of the two free surfaces whin the angular velocity is 100 revolutions per minute?

Q5. Water flows through a 0.9m diametre pipe at the end of which there is a reducer connecting to a 0.6m diameter pipe. If the gauge pressure at the entrance to the reducer is 412.02 KN/m^2 and the velocity is 2 m/s, determint the resultant thrust on the reducer, assuming that the frictional loss of head in the reducer is 1.5 m.

Q6. Derive continuity equation for a three dimensional steady or unsteady flows in a Cartesian coordinate system.

Q7. With the help of a diagram explain Streamlines, equipotentiol lines and flow net. Prove that equipotential lines and stream lines intersect each other orthogonally.

Q8. Two velocity components are given in the following equations, find the third component such that they satisfy the continuity equation:

$$u = x^3 + y^2 + 2z^2; v = -x^2 y - yz - xy$$

Q9. For laminar flow of an oil having dynamic viscosity u=1.766 Ps.s in a 0.3 m diameter pipe, the velocity distribution is parabolic with a maximum point velocity of 3 m/s at the centre of the pipe. Calculate the shear stresses at the pipe wall and within the fluid 50 mm from the pipe wall.

Section-C

Note: Attempt any two questions from this section.

(15×2=30)

Q10. The velocity components in a two-dimensional flow field for an incompressible fluid are expressed as

$$u = \frac{y^3}{3} + 2x - x^2 y; v = xy - 2y - \frac{x3}{3}$$

(a) Show that these functions represent a possible case if an irrotational flow.

(b) Obtain an expression for steam function ψ

(c) Obtain an expression for velocity potential

Q11. A rectangular door covering an opening 3 m wide and 2

m high in a vertical wall is hinged about its vertical edge by two pivots placed symmetrically 0.25 m from either end. The door is locked by a clamp placed at the centre of the vertical edge. Derermine the reactions at the two hinges and the clamp, when the height of water is 1.5 m above the top edge of the opening.

Q12. (a) For the velocity distribution

$$\frac{u}{U} = 2\left(\frac{y}{g}\right) - \left(\frac{y}{g}\right)^2$$

, find the energy thickness **

(b) A compound piping system consists of 1800 m of 0.50 m, 1200 m of 0.40 m and 600 m of 0.30 m new cast iron pipes connected in series. Convert the system to (i) an equivalent length of 0.40 m pipe, and (ii) equivalent size pipe 3600 m long.

(c) The pressure drop ' $_p$ ' in a pipe of diammetre 'D' and length 'L' due to viscous flow depends on the velocity 'v', dynamic viscosity ' ', average height 'k' and mass density 'p' using Buckingham's theorem, obtain expression for ' $_p$ '.

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