Register Number: ……

B.E. DEGREE EXAMINATIONS: NOV/DEC 2010

Third Semester

CIVIL ENGINEERING

CEE 104: Mechanics of Fluids

Time: Three Hours **Maximum Marks: 100**

Answer ALL Questions:-

PART A (10 x 1 = 10 Marks)

1. The property of a fluid which determines its resistance to shearing stress is
   a) Viscosity b) Surface tension c) Compressibility d) Capillarity
2. The phenomenon by which a liquid rises or drops into a thin glass tube above or below its general level is
   a) Cohesion b) Capillarity c) Adhesion d) Surface tension
3. The manometers are suitable for comparatively
   a) Low pressure b) High pressure c) Very low pressure d) Very high pressure
4. The magnitude of the buoyant force can be determined by
   a) Newton's second law of motion b) Archimede's principle
   c) Principle of moments d) Kirchhoff's principle
5. Flow in a pipe where average flow parameters are considered for analysis is an example of
   a) Incompressible flow b) One-dimensional flow
   c) Two-dimensional flow d) Three-dimensional flow
6. The concept of stream function which is based on the principle of continuity is applicable to
   a) Irrotational flow only b) Two-dimensional flow only
   c) Uniform flow only d) Three-dimensional flow only
7. A venturimeter is used for measuring_____ in a pipe
   a) Pressure b) Flow rate c) Total energy d) Piezometric head
8. Darcy-weisbach equation is used to find loss of head due to
   a) Sudden enlargement b) Sudden contraction
   c) Obstruction in the pipe d) Friction
9. The product of shear stress due to viscosity and surface area of flow is _____ force.
   a) Viscous b) Inertia c) Pressure d) Gravity
10. The ratio of the inertia force to the elastic force is
    a) Froude's number b) Weber's number c) Reynold's number d) Mach's number

PART B (10 x 2 = 20 Marks)

11. What are fluids?
12. Give some examples of phenomenon of surface tension.
13. List the devices used for measuring the intensity of pressure.
14. Define buoyancy.
15. What is continuity equation?
16. Define velocity potential function.

17. What are the assumptions made in the derivation of Bernoulli's equation?
18. Differentiate laminar flow from turbulent flow.
19. State Buckingham's π theorem.
20. Define similitude.

PART C (5 x 14 = 70 Marks)

21. a) (i) Explain the different types of fluid. (5)

(ii) The velocity distribution over a plate is given by, $v = (1/3\ y) - y^2$ in which v the velocity in m/sec at a distance y meters above the plate. Determine the shear stress at y = 0 and y = 0.1m. Take $\mu = 0.835$ Ns/m^2. (9)

(OR)

b) (i) The dynamic viscosity of oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4m and rotates at 190rpm.Calculate the power lost in the bearing for a sleeve length 90mm.The thickness of the oil film is 1.5mm. (9)

(ii) Prove that the relationship between surface tension and pressure inside a droplet of liquid in excess of outside pressure is given by $\rho = 4\sigma/d$. (5)

22. a) (i) State and prove hydrostatic law. (5)

(ii) An open tank contains water up to a depth of 1.5m and above it an oil of specific gravity 0.8 for a depth of 2m. Find the pressure intensity (i) at the interface of the two liquids, and (ii) at the bottom of the tank. (9)

(OR)

b) (i) A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40cm and manometer liquid in the left limb is 15 cm below the centre of the pipe. (5)

(ii) Derive an expression for the total pressure and position of centre of pressure on vertical plane surface. (9)

23. a) A fluid flow is given by, $V = XY^2\ i - 2YZ^2\ j - [3Y^2 - (2Z^3/3)]\ k$

(i) Prove that it is a case of possible steady incompressible fluid flow.

(ii) Calculate the velocity and acceleration at the point (1,2,3) **(OR)**

b) (i) What do you mean by equipotential line and stream line. (5)

(ii) The velocity potential function (φ) is given by an expression

$$\varphi = -\frac{xy^3}{3} - x^2 + \frac{x^3 y}{3} + y^2 .$$

(i) Find the velocity components in x and y direction.

(ii) Show that φ represents a possible case of flow. (9)

24. a) Derive for Hagen Poiseuille's equation. **(OR)**

b) At a sudden enlargement of a water main from 240mm to 480mm diameter, the hydraulic grade line rises by 10mm. Estimate the rate of flow.

25. a) (i) The resisting force R of a supersonic plane during flight can be considered as dependent upon the length of the aircraft l , velocity V, air viscosity μ, air density ρ and bulk modulus of air K. Express the functional relationship between these variables and the resisting force. (9)

(ii) Prove that the scale ratio for discharge for a distorted model is given as (5)

$$\frac{Q_p}{Q_m} = (L_r)_H (L_r)_V^{3/2}$$

Where Q_p = Discharge through prototype

Q_m = Discharge through model

$(L_r)_H$ = Horizontal scale ratio

$(L_r)_V$ = Vertical scale ratio

(OR)

b) The pressure difference ΔP in a pipe of diameter D and length l due to viscous flow depends on the velocity V, viscosity μ and density ρ . Using Buckingham's π theorem, obtain an expression for ΔP.

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