Fluid Mechanics VTU CBCS Question Paper Set 2018

CBCS Scheme

USN | | | | | | | | | | 15AU42

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing one full question from each module.***

Module-1

1 a. Define the following fluid properties and write their unit:
(i) Density (ii) Specific weight (iii) Specific volume (iv) Specific gravity. **(08 Marks)**

b. Calculate the capillary rise in a glass tube of 2.5 mm diameter when immersed vertically in (i) Water and (ii) Mercury. Take surface Tensions σ = 0.0725 N/m for water and σ = 0.52 N/m, For mercury in contact with air. The specific gravity for mercury is given as 13.6 and angle of contact is 130°. **(08 Marks)**

OR

2 a. State and explain Pascal's law. Derive the equation also. **(06 Marks)**

b. What is total pressure and centre of pressure? **(03 Marks)**

c. Determine the total pressure and centre of pressure on an isosceles triangular plate of base 4 m and altitude 4 m. When it is immersed vertically in an oil of specific gravity 0.9. The base of the plate coincides with the free surface of oil. **(07 Marks)**

Module-2

3 a. Explain the terms:
(i) Buoyancy (ii) Centre of buoyancy (iii) Meta-centre (iv) Meta-centric height **(04 Marks)**

b. Explain conditions of equilibrium of a floating body and a submerged body. **(06 Marks)**

c. A block of wood of specific gravity 0.7 floats in water. Determine the meta centric height of the block. If its size is 2m × 1m × 0.8m **(06 Marks)**

OR

4 a. Explain the following:
(i) Steady and unsteady flow.
(ii) Uniform and non-uniform flow.
(iii) Laminar and turbulent flow.
(iv) Rotational and irrotational flow. **(08 Marks)**

b. The stream function for a 2-D flow is given by, $\psi = 8xy$. Calculate the velocity at a point P(4, 5). Find also the velocity potential function. **(08 Marks)**

Module-3

5 a. Derive Euler's equation of motion for one-dimension flow along a stream line. State the assumptions. **(08 Marks)**

b. A horizontal water pipe of diameter 150 mm converges to a diameter of 75 mm. If the pressure at the two sections are 400 kN/m^2 and 150 kN/m^2 respectively. Calculate the flow rate of water. **(08 Marks)**

OR

6 a. What is venturimeter? Derive an expression for discharge through the venturimeter. **(08 Marks)**

b. Water flows over a rectangular notch 1 m wide with a head of 15 cm and afterwards passes through a triangular (V-notch) of 90°. Taking C_d for the rectangular and V-notch as 0.62 and 0.59 respectively. Find the head over the triangular notch. **(08 Marks)**

Module-4

7 a. What is dimensional analysis? State Buckingham π-theorem and explain the procedure to determine π groups. **(08 Marks)**

b. Using Buckingham π-theorem. Show that the velocity through the circular orifice is given by,

$$V = \sqrt{2gH}\phi\left(\frac{D}{H}, \frac{\mu}{\rho VH}\right)$$

where H = head, ρ = mass density, g = Acceleration due to gravity
D = Diameter of orifice, μ = Co-efficient of viscosity **(08 Marks)**

OR

8 a. Derive an expression for the loss of head due to sudden enlargement in pipe flow. **(08 Marks)**

b. A 10 m long water pipe is laid at a slope of 3 in 4. The diameter of the lower end and upper end are 120 mm and 180 mm respectively. Pressure gauges fixed at the lower end and upper end reads 0.2 MPa and 0.3 MPa respectively. Determine the flow rate of water through the pipe. **(08 Marks)**

Module-5

9 a. Starting from basic principle derive an expression for velocity and shear stress distribution for laminar flow between two fixed parallel plates. **(08 Marks)**

b. An oil of viscosity 10 poise flow between two parallel fixed plates which are kept at a distance 50 mm apart. Find the rates of flow of oil between the plates if the drop of pressure in a length of 1.2 m be 0.3 N/cm^2. The width of the plates is 200 mm. **(08 Marks)**

OR

10 a. What is meant by drag and lift? Derive an expression for drag and lift. **(08 Marks)**

b. A man descends to the ground from an aeroplane with the help of a parachute which is hemispherical having a diameter of 4 m against. The resistance of air with a uniform velocity of 25 m/s. Find the weight of the man if the weight of Parachute is 9.81 N. Take $C_D = 0.6$. **(08 Marks)**

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CBCS Scheme

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15AU42

Fourth Semester B.E. Degree Examination, June/July 2017
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: ***Answer FIVE full questions, choosing one full question from each module.***

Module-1

1 a. Define the following terms and mention their S.I. units:
(i) Surface tension.
(ii) Specific gravity.
(iii) Specific weight.
(iv) Kinematic viscosity. **(08 Marks)**

b. Define capillarity, obtain an expression for capillary rise of a liquid. **(06 Marks)**

c. State Newton's law of viscosity. **(02 Marks)**

OR

2 a. State and prove the Pascal's law. **(08 Marks)**

b. A differential manometer is connected at the two points A and B of two pipes as shown in Fig. Q2 (b). The pipe A contains a liquid of specific gravity = 1.5. While pipe B contains a liquid of specific gravity = 0.9. The pressures at A and B are 1 kgf/cm^2 and 1.80 kgf/cm^2 respectively. Find the difference in mercury level in the differential manometer. **(08 Marks)**

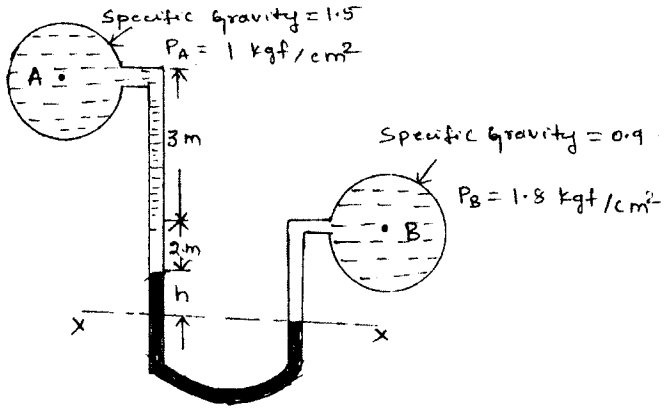

Fig. Q2 (b)

Module-2

3 a. Derive an expression for metacentric height of a floating body using analytical method. **(08 Marks)**

b. A block of wood of specific gravity 0.7 floats in water. Determine the meta-centric height of the block if its size is $2m \times 1m \times 0.8m$. **(08 Marks)**

OR

4 a. Derive an expression for continuity equation for three dimensional flow in Cartesian co-ordiantes. **(08 Marks)**

b. The velocity components in a two-dimensional flow field for an incompressible fluid are as follows $u = \frac{y^3}{3} + 2x - x^2y$ and $v = xy^2 - 2y - \frac{x^3}{3}$. Obtain an expression for the stream function ψ. **(08 Marks)**

Module-3

5 a. Derive Euler's equation of motion along a stream line. Also derive Bernoulli's equation from Euler's equation of motion and list the assumptions made for deriving Bernoulli's equation. **(10 Marks)**

b. Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/cm^2 and the pressure at the upper end is 9.81 N/cm^2. Determine the difference in datum head if the rate of flow through pipe is 40 lit/s. **(06 Marks)**

OR

6 a. Derive an expression for the actual discharge through Venturimeter. **(10 Marks)**

b. An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter gives readings of 19.62 N/cm^2 and 9.81 N/cm^2 respectively. Co-efficient of discharge for the meter is given as 0.6. Find the discharge of water through pipe. **(06 Marks)**

Module-4

7 a. The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$. Prove this by using Buckingham's π-theorem. **(08 Marks)**

b. (i) What do you mean by,
- Geometric similarity
- kinematic similarity
- Dynamic similarity. **(04 Marks)**

(ii) State Buckingham's π-theorem. List out the methods of selecting repeating variables. **(04 Marks)**

OR

8 a. Derive the Darcy-Weisback equation for the loss of head due to friction in a pipe. **(08 Marks)**

b. The rate of flow of water through a horizontal pipe is 0.25 m^3/s. The diameter of the pipe which is 200 mm is suddenly enlarged to 400 mm. The pressure intensity in the smaller pipe is 11.772 N/cm^2. Determine
(i) Loss of head due to sudden enlargement.
(ii) Pressure intensity in the large pipe.
(iii) Power lost due to enlargement. **(08 Marks)**

Module-5

9 a. Derive an expression for shear stress distribution and velocity distribution for laminar flow through circular pipe. **(08 Marks)**

b. Water at 15°C flows between two large parallel plates at a distance of 1.6 mm apart determine (i) the maximum velocity (ii) the pressure drop per unit length and (iii) the stress at the walls of the plates if the average velocity is 0.2 m/s. The viscosity of water at 15°C is given as 0.01 poise. **(08 Marks)**

OR

10 a. Define the following and write their equations :
(i) Drag (ii) Lift (iii) Displacement thickness (iv) Momentum thickness **(08 Marks)**

b. Explain Mach Angle and Mach Cone. **(04 Marks)**

c. A projectile is traveling in air having pressure and temperature as 8.829 N/cm^2 and -2°C. If the Mach angle is 40°. Find the velocity of the projectile.
Take K = 1.4 and R = 287 J/kg°K **(04 Marks)**

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