CBCS Scheme

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15MR46

Fourth Semester B.E. Degree Examination, June/July 2018
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Explain following fluid properties with relevant equations:
(i) Bulk modulus. (ii) Capillarity.
(iii) Surface tension. (iv) Mass density and specific weight. **(08 Marks)**

b. A vertical gap 2.2 cm wide of infinite extent contains a fluid of viscosity 2 N-sec/m^2 and specific gravity 0.9. A metallic plate 1.2m × 1.2m × 0.2cm is to be lifted up with a constant velocity of 0.15 m/sec through the gap. If the plate in the middle of the gap, find the force required if the weight of plate is 40 N. **(08 Marks)**

OR

2 a. Derive an expression for the depth of centre of pressure from free surface of liquid of a inclined plane surface submerged in liquid. **(08 Marks)**

b. Explain Gauge pressure and Vaccum pressure with reference point. **(04 Marks)**

c. An inverted U-tube manometer is connected to the two points A and B of two horizontal pipes. The vertical distance between the axes of these pipes is 30 cm. When an oil of specific gravity 0.8 is used as a gauge fluid. The vertical heights of water columns in the two limbs of inverted manometer (when measured from respective centre lines of the pipes A and B) are found to be same and equal to 35 cm. Determine the difference of pressure between the pipes. **(04 Marks)**

Module-2

3 a. What is metacentric? Explain stability of floating body. With usual notation derive expression for metacentric height for a floating body in liquid. **(08 Marks)**

b. A trapezoidal channel 2 m wide at the bottom and 1 m deep has side slopes 1 : 1 determine (i) Total pressure force (ii) The point of application of centre of pressure on the vertical gate closing the channel when it is full of water. **(08 Marks)**

OR

4 a. Define the equation of continuity. Obtain an expression for continuity equation for a three dimensional steady incompressible flow. **(08 Marks)**

b. Derive Bernoulli's equation from fundamentals. List all the assumptions made. **(08 Marks)**

Module-3

5 a. Derive the expression for rate of flow through rectangular notches. **(06 Marks)**

b. Explain with reference to dimensional analysis (i) Kinematic similarity (ii) Dynamic similarity. **(04 Marks)**

c. A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of water. The pressure at inlet is 147 KPa and vaccum pressure at the throat is 40 cm of mercury. Find the discharge of water through venturimeter. Take $C_d = 0.98$ **(06 Marks)**

OR

6 a. Derive equation for velocity measurement by pitot tube. **(04 Marks)**

b. Explain Mach number and Reynolds number. **(04 Marks)**

c. The function 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 that $T = D^5N^2\rho\phi\left[\frac{u}{D^2N\rho}\right]$ hence prove by taking D, N and ρ as repeating variables by Buckingham π theorem. **(08 Marks)**

Module-4

7 a. Derive Darcy Weisbach and Chezy's equation for loss of head due to friction in pipes. **(10 Marks)**

b. The rate of flow of water through a horizontal pipe is 0.25 m^3/sec. The diameter of the pipe which is 200 mm is suddenly to 400 mm. The pressure intensity in smaller pipe is 11.772 N/cm^2. Determine

(i) Loss of head due to sudden enlargement.

(ii) Pressure intensity in the larger pipe. **(06 Marks)**

OR

8 a. Derive Hagen-Poseuille equation for a laminar flow in a circular tube. **(10 Marks)**

b. An oil of viscosity 10 poise flows between two parallel fixed plates which are kept at a distance of 50 mm apart. Find the rate of flow of oil between the plates if the drop of pressure in a length of 1.2 m be 0.3 N/cm^3. The width of the plates is 200 mm. **(06 Marks)**

Module-5

9 a. Explain the terms (i) Lift (ii) Drag (iii) Displacement thickness (iv) Momentum thickness. **(08 Marks)**

b. A flat plate 1.5m × 1.5m moves at 50 kmph in stationary air of density 1.15 kg/m^3. If the co-efficient of drag and lift are 0.15 and 0.75 respectively. Determine

(i) The drag force.

(ii) The lift force.

(iii) The resultant force.

(iv) Power required to keep the plate in motion. **(08 Marks)**

OR

10 a. With a neat sketches, explain the propogation of pressure waves in a compressible fluid for M = 1 and M > 1. **(08 Marks)**

b. Find the velocity of bullet fired instandard air if the mach angle is 30°. Take R = 287.14 J/kgK, K = 1.4 for air. Assume temperature as 15°C. **(06 Marks)**

c. Explain Mach angle. **(02 Marks)**

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