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10MEB/AUB406

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019

Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Give reasons for the following:
i) Viscosity of gases increases with rise in temperature
ii) Rise of water level in a capillary tube
iii) Cavitation in a pipe flow
iv) Thin objects can float on film membrane or free surface of liquids
v) Mercury is used as manometric liquid and also in thermometers. **(10 Marks)**

b. Derive an expression for pressure intensity in a soap bubble. **(05 Marks)**

c. The surface tension of a spherical water droplet in contact with air at 25°C is 0.072 N/m. If the diameter of the droplet is 1.5 mm, determine the pressure within the droplet. Find also absolute pressure. **(05 Marks)**

2 a. Derive the expression for hydrostatic force and centre of pressure on a submerged plane surface, inclined at an angle 'θ' to the free surface of liquid with specific weight 'ω_L'. **(10 Marks)**

b. Pressure measured at base and top of a mountain are 90 cm and 70 cm of mercury respectively. Calculate height of the mountain, if air has a specific weight of 12.23 N/m^3. **(05 Marks)**

c. A simple manometer is used to measure pressure of oil (sp.gr. 0.90) flowing in a pipe of diameter 50 cm. Its right limb is open and left limb is connected to pipe. Centre of pipe is 15 cm below the level of mercury in right limb and difference in mercury levels is 25 cm. Determine the absolute pressure of oil. **(05 Marks)**

3 a. Differentiate between the following:
i) Rotational flow and irrotation flow
ii) Steady flow and laminar flow
iii) Stream line and path line
iv) Metacentre and centre of Baoyancy
v) Stable and unstable equilibrium **(10 Marks)**

b. A metallic body floats at interface of mercury (13.6) and water in such a way that 30% of its volume is submerged in mercury and 70% in water. Find density of the metallic body. **(05 Marks)**

c. A stream function is given by $\psi = 2x^2 - y^3$. Find the velocity components and resultant velocity at a point P(4, 5). **(05 Marks)**

4 a. State the assumptions made in derivation of Bernoulli's equation for a fluid flow. Represent the Bernoulli's equation for practical fluid flow with losses between two points, with a neat sketch. **(06 Marks)**

b. A pipeline carries oil of specific gravity (0.90) changes in diameter from 200 mm at point A to 400 mm diameter at point B, which is 4 meters higher than point A. If the pressure intensity at points A is 9.81 N/cm^2 and point B is 4.5 N/cm^2 respectively, and the discharge is 200 kg/sec, determine the loss of head and direction of flow. **(14 Marks)**

PART – B

5 a. Differentiate between orifice meter and venturimeter with neat sketches and working. **(04 Marks)**

b. Explain working of V-Notch and derive a relation for discharge of fluid. **(06 Marks)**

c. Using Buckingham's π-theorem, show that the velocity of flow through a circular orifice is given by $V = \sqrt{2gH}\ \phi\left[\frac{D}{H}, \frac{\mu}{\rho VD}\right]$, where H is Head causing flow, D is diameter of the orifice, μ is dynamic viscosity, ρ specific density and 'g' is gravitational acceleration. **(10 Marks)**

6 a. List the types of losses with equations. **(04 Marks)**

b. Derive 'loss of head' expression for Sudden Enlargement of a pipe. **(06 Marks)**

c. Determine the difference in water level between two reservoirs which are connected by a horizontal pipe of dia 200 mm and 500 meters long. The rate of flow through the pipe is 45 ℓt/sec (0.045 m^3/s). Consider all the losses and assume f = 0.01. Neatly sketch HGL and TEL between the two reservoirs. **(10 Marks)**

7 a. Derive an expression for laminar flow through circular pipe. **(10 Marks)**

b. A fluid of viscosity 0.9 N.S/m2 and specific gravity 1.25 is flowing through two parallel plates 3 mm apart. Determine the following:
i) Maximum velocity
ii) Pressure drop per unit length
iii) Shear stress at the walls of plate if the average velocity is 0.2 m/sec.
Assume temperature is 20°C. **(10 Marks)**

8 a. Define Mach number and Mach angle. With neat sketch derive relation for velocity of sound in a compressible fluid. **(10 Marks)**

b. Define: (i) Lift (ii) Momentum thickness (iii) displacement thick (iv) Mach cone (v) Drag **(10 Marks)**

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