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CE 131305

Roll No. of candidate

2019

B.Tech. 3rd Semester End-Term Examination

Civil

BASIC FLUID MECHANICS

(For New Regulation)

(w.e.f 2017–18)

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer Question No. 1 and any *four* from the rest.

1. Answer the following questions : (10 × 1 = 10)

(i) An ideal fluid is defined as the fluid which

(a) is compressible

(b) is incompressible

(c) is incompressible and non-viscous

(d) has negligible surface tension

(ii) Dynamic viscosity (μ) has the dimensions as

(a) ML/T^2 (b) M/LT

(c) M/LT^2 (d) $1/MLT$

(iii) Surface tension has the units of

(a) Force per unit area

(b) Force per unit length

(c) Force per unit volume

(d) None of the above

(iv) The hydrostatic law states that rate increase of pressure in a vertically downward direction

(a) is equal to density of the fluid

(b) is equal to specific weight of the fluid

(c) is equal to the weight of the fluid

(d) none of the above

(v) Atmospheric pressure head in terms of water column is

(a) 7.5 m (b) 8.5 m

(c) 9.81 m (d) 10.33 m

(vi) When the fluid is at rest, the shear stress is

(a) Maximum (b) Zero

(c) Unpredictable (d) None of the above

(vii) The point about which a floating body, starts oscillating when the body is titled is called

(a) Centre of pressure

(b) Centre of buoyancy

(c) Centre of Gravity

(d) Metacentre

(viii) Bernoulli's theorem deals with the law of conservation of

(a) Mass (b) Momentum

(c) Energy (d) None of the above

(ix) If the velocity, pressure, density etc. change at a point with respect to time, the flow is called

(a) Non uniform (b) Compressible

(c) Unsteady (d) Incompressible

(x) For a submerged curved surface, the horizontal component of force due to static liquid is equal to

(a) weight on liquid supported by the curved surface

(b) force on a projection of the curved surface on a vertical plane

(c) area of curved surface × Pressure at the centroid of the submerged area

(d) None of the above

Answer the following questions :

2. (a) Explain how the position of the metacentre in relation to the centre of gravity affects the stability of a floating body. (4)

(b) Derive an expression for the depth of centre of pressure from the free surface of liquid of a vertically immersed plane surface. (5)

(c) A rectangular plate of 0.5 m × 0.50 m dimensions weighing 500 N slides down an inclined plane making 30° angle with horizontal, at a velocity of 1.75 m/sec. If the 2 mm gap between the plate and the inclined surface is filled with lubricating oil, find its viscosity and express it in poise as well as in Ns/m^2. (6)

3. Answer the following questions

(a) Define the following terms : (4)

(i) Specific weight

(ii) Specific gravity

(iii) Steady flow

(iv) Co-efficient of contraction

(b) Derive the Darcy-Weisbach equation of friction loss. (5)

(c) Water is flowing through a pipe having diameters 20 cm and 15 cm at sections 1 and 2 respectively. The rate of flow through pipe is 40 litres/sec. The section 1 is 6 m above datum line and section 2 is 3 m above datum. If the pressure at section 1 is 29.43 N/cm^2, find the intensity of pressure at section 2. (6)

4. Answer the following questions

(a) List the various minor losses of head in pipe flow and write the expression for each loss. (4)

(b) What is broad crested weir? Derive the expression for maximum discharge over a broad crested weir. (6)

(c) A block of wood of specific gravity 0.8 floats in water. Determine the metacentric height of the block is its size is 3 m × 2 m × 1 m. (5)

5. Answer the following questions

(a) Find the surface tension in a soap bubble of 30 mm dia when the inside pressure is 1.962 N/m^2 above atmosphere. (2)

(b) Explain with a neat sketch the working of a U-Tube manometer for gauge pressure. (4)

(c) The diameter of a pipe at the section 1 and 2 are 15 cm and 20 cm respectively. Find the discharge through the pipe if the velocity of water at section 1 is 4 m/sec. Determine also the velocity at section 2. (3)

(d) A rectangular orifice of 1.5 m wide and 1.2 m deep is fitted in one side of a large tank. The water level on one side of the orifice is 2 m above the top edge of the orifice, while on the other side of the orifice, the water level is 0.4 m below its top edge. Calculate the discharge through the orifice if $C_d = 0.62$. (6)

6. Answer the following questions

(a) What are the differences between a notch and a weir? Find an expression for the discharge over a rectangular weir in terms of head of water over the crest of the weir. (5)

(b) Determine the rate of flow of water through a pipe of diameter 20 cm and length 50 m when one end of the pipe is connected to a tank and the other end of the pipe is open to the atmosphere. The pipe is horizontal and height of water in the tank is 4 m above the centre of the pipe. Consider all losses and take co-efficient in friction, f = 0.009. (6)

(c) Explain the terms : (4)

(i) Path line

(ii) Streak line

(iii) Stream line

(iv) Stream tube

7. Answer the following questions

(a) If the velocity of a flow is given by $V = -y^2 i - 6xj$, determine the equation of the stream line passing through (2, 2). (3)

(b) The stream function for a two dimensional flow is given by $\psi = 2xy$, calculate the velocity at the point P (2, 3). (2)

(c) Name five non-dimensional parameters, mentioning the force involved against each parameter as a ratio to the inertia force. (5)

(d) In 1:30 model of a spillway, the velocity and discharge are 1.5 m/sec and 2.0 m^3/sec. Find the corresponding velocity and discharge in the prototype. (5)
