



Third Semester B.E. Degree Examination, Jan./Feb. 2021 Fluid Mechanics

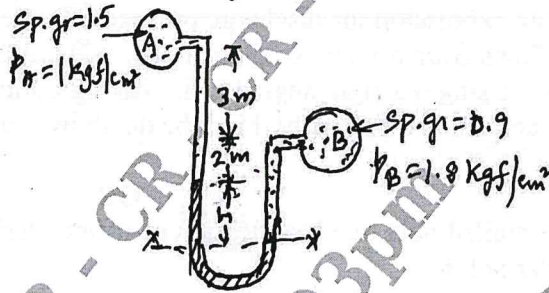
Max. Marks: 100

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

Module-1

- 1 a. Define the following fluid properties. Also mention their units.
 - i) Specific Gravity ii) Viscosity iii) Mass Density iv) Specific Volume. (06 Marks)
- b. Define capillarity and derive expressions for capillary rise and capillary fall. (06 Marks)
- c. A differential manometer is connected at the two points A and B of two pipes as shown in Fig.Q.1(c). The pipe A contains a liquid of specific gravity of 1.5, while pipe B contains a liquid of specific gravity of 0.9. The pressures at A and B are 1 kgf/cm^2 and 1.8 kgf/cm^2 respectively. Find the difference in mercury level in the differential manometer. (08 Marks)

Fig.Q.1(c)



OR

- 2 a. With neat sketch, explain Bourdon tube pressure gauge. (06 Marks)
- b. State and prove hydrostatic law of pressure. (06 Marks)
- c. The dynamic viscosity of an oil used for lubrication between a shaft and sleeve is $0.6 \text{ N}\cdot\text{sec}/\text{m}^2$. The shaft is of diameter 0.4 m and rotates at 190 rpm . Calculate the power lost in the bearing for a sleeve length of 90 mm . The thickness of the oil film is 1.5 mm . (08 Marks)

Module-2

- 3 a. Define total pressure and centre of pressure. Also derive expressions for total pressure and centre of pressure for a plane surface submerged vertically in a liquid. (08 Marks)
- b. Distinguish between:
 - i) Laminar Flow and turbulent flow
 - ii) Uniform flow and non uniform flow
 - iii) Steady flow and unsteady flow. (06 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. (06 Marks)

OR

- 4 a. Derive the three dimensional continuity equation in the Cartesian coordinates. (06 Marks)
- b. The velocity vector \mathbf{n} a fluid flow is given as $\mathbf{V} = 4x^3\mathbf{i} - 10x^2y\mathbf{j} + 2t\mathbf{k}$. Find the velocity and acceleration of a fluid particle at $(2, 1, 3)$ at time $t=1$. (08 Marks)
- c. Determine the total pressure on a circular plate of diameter 1.5 m which is placed vertically in water in such a way that the centre of the plate is 3 m below the free surface of water. Find the position of centre of pressure also. (06 Marks)

Module-3

- 5 a. Define free vortex flow and forced vortex flow. Also mention two examples for each. (04 Marks)
- b. Derive Euler's equation of motion along a stream line and obtain Bernoulli's equation from Euler's equation. Also mention the assumptions made in derivation. (10 Marks)
- c. A 30cm × 15cm venturimeter is inserted on a vertical pipe carrying water, flowing in upward direction. A differential mercury manometer connected to the inlet and throat gives a reading of 20cm. Find the discharge. Take $C_d = 0.98$. (06 Marks)

OR

- 6 a. Derive an expression for discharge through a venturimeter. (06 Marks)
- b. List the various instruments that works on the Bernoulli's principle. Also explain how pilot tube is used to measure velocity of flow. (06 Marks)
- c. A 300mm diameter pipe carries water under a head of 20m with a velocity of 3.5m/s. If the axis of the pipe turns through 45° , find the magnitude and direction of the resultant force on the bend. (08 Marks)

Module-4

- 7 a. Give a detailed note on classification of orifices mouth pieces. (06 Marks)
- b. Derive an expression for discharge through a Borda's mouth piece running free. (06 Marks)
- c. Water flows over a rectangular weir 1m wide at a depth of 150mm and afterwards passes through a triangular right angled weir. Taking C_d for the rectangular weir and triangular weir as 0.62 and 0.59 respectively. Find the depth over triangular weir. (08 Marks)

OR

- 8 a. Give a detailed note on classification of weirs. Derive an expression for discharge through a triangular notch. (10 Marks)
- b. Define hydraulic coefficients. Also mention the general values of hydraulic coefficients. (06 Marks)
- c. A jet of water, issuing from a sharp edged vertical orifice under a constant head of 10cm at a certain point, has the horizontal and vertical coordinates measured from the vena-contracta as 20cm and 10.5cm respectively. Find the value of C_v and also value of C_c if $C_d = 0.6$. (04 Marks)

Module-5

- 9 a. Give a brief note on loss of energy in pipes. Also derive Darcy's Weisbach equation for loss of energy due to friction. (10 Marks)
- b. Give a brief note on water hammer in pipes. (04 Marks)
- c. Three pipes of lengths 800m, 500m and 400m and diameters 500mm, 400mm and 300mm respectively are connected in series. These pipes are to be replaced by a single pipe of length 1700m. Find the diameter of the single pipe. (06 Marks)

OR

- 10 a. Derive an expression for the loss of head due to sudden enlargement of pipe section. (08 Marks)
- b. The water is flowing with a velocity of 1.5m/s in a pipe of length 2500m and of diameter 500mm. At the end of the pipe, a valve is provided. Find the rise in pressure if the valve is closed in 25 seconds. Take the value of $C = 1460\text{m/s}$. (06 Marks)
- c. An oil of specific gravity 0.7 is flowing through a pipe of diameter 300mm at the rate of 500l/s. Find the head lost due to friction and power required to maintain the flow for a length of 1000m. Take $\gamma = 0.29$ stokes. (06 Marks)

