

R16

Code No: 133AV

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech II Year I Semester Examinations, February - 2024

FLUID MECHANICS – I

(Civil Engineering)

Time: 3 Hours

Max. Marks: 75

Note: i) Question paper consists of Part A, Part B.

ii) Part A is compulsory, which carries 25 marks. In Part A, answer all questions.

iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

- 1.a) What do you understand by hydrostatic law? [2]
- b) Determine the specific gravity of a fluid having a viscosity of 0.05 poise and a kinematic viscosity of 0.035 stokes. [3]
- c) What is rotational and irrotational flow? [2]
- d) List out the applications of flow net. [3]
- e) Differentiate the small orifice and large orifice [2]
- f) What are the applications of the momentum equation? [3]
- g) Define the Total energy line. [2]
- h) Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m, through which water is flowing at a velocity of 3 m/s using Darcy's formula. [3]
- i) What is meant by the Magnus effect? [2]
- j) Define the drag and lift force of an object immersed in a liquid. [3]

PART – B

(50 Marks)

- 2.a) The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of sp. gr. 0.9 is flowing. The center of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm.
- b) A circular plate 3 m diameter is immersed in water in such a way that its greatest and least depth below the free surface are 4 m and 1.5 m respectively. Determine the total pressure on one face of the plate and the position of the center of pressure. [5+5]

OR

- 3.a) A circular opening, 3 m diameter, in the vertical side of a tank is closed by a disc of 3 m diameter which can rotate about a horizontal diameter. Calculate:
 - i) the force on the disc, and
 - ii) the torque required to maintain the disc in equilibrium in the vertical position when the head of water above the horizontal diameter is 4 m.
- b) What do you mean by single-column manometers? How are they used for the measurement of pressure? [5+5]

4.a) If for a two-dimensional potential flow, the velocity potential is given by $\Phi = x(2y - 1)$. Determine the velocity at the point p (4, 5). Determine also the value of stream function Ψ at the point P.

b) Differentiate between (i) Steady and Unsteady flow (ii) Uniform and non-uniform flow (iii) Laminar and turbulent flow (iv) Rotational and irrotational flow. [5+5]

OR

5.a) Water flows through a pipe AB 1.2 m diameter at 3 m/s and then passes through a pipe BC 1.5 m diameter. At C, the pipe branches. Branch CD is 0.8 m in diameter and carries one-third of the flow in AB. The flow velocity in branch CE is 2.5 m/s. Find the volume rate of flow in AB, the velocity in BC, the velocity in CD and the diameter of CE.

b) A solid cylinder of diameter 4 m has a height of 3 meters. Find the meta-centric height of the cylinder when it is floating in water with its axis vertical. The sp. gr. of the cylinder = 0.6. [5+5]

6.a) What are the different types of notches? Explain Rectangular and Stepped notches.

b) A horizontal venturi meter with an inlet diameter of 30cm and a throat diameter of 12cm is used to measure the flow of oil of sp.gr.0.8. The discharge of oil through the venturi meter is 60lit/s. Find the reading of the oil-mercury differential manometer. Take $C_d=0.98$. [5+5]

OR

7.a) A pipeline carrying oil of specific gravity 0.87, changes in diameter from 200 mm diameter at position A to 500 mm diameter at position B which is 4 meters at a higher level. If the pressure at A and B are 9.81 N/cm² and 5.886 N/cm² respectively and the discharge is 200 litres/s. determine the loss of head and direction of flow.

b) The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 litres/s. the pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm². [5+5]

8.a) Explain the minor losses in pipe in series and parallel.

b) The water is flowing with a velocity of 1.5 m/s in a pipe of length 2500 m and of diameter 500 mm. 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 $C = 1460$ m/s. [5+5]

OR

9.a) A pipe of diameter 20 cm and length 2000 m connects two reservoirs, having a difference of water levels as 20 m. Determine the discharge through the pipe. If an additional pipe of diameter 20 cm and length 1200 m is attached to the last 1200 m length of the existing pipe, find the increase in the discharge. Take $f = .015$ and neglect minor losses.

b) Determine the difference in the elevations between the water surfaces in the two tanks which are connected by a horizontal pipe of diameter 300 mm and length 400 m. The rate of flow of water through the pipe is 300 litres/s. consider all losses and take the value of $f = 0.008$. [5+5]

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- 10.a) It is required to determine the frictional drag of a submarine. The length of the hull is 75m and its surface area is 3000m^2 . The submarine is traveling at a constant speed of 5 m/s. critical Reynolds number at which the flow in the boundary layer changes from laminar to turbulent is 5×10^5 . Assuming that the boundary layer at the leading edge is laminar, obtain the frictional drag and the power required to propel the submarine at 5m/s. Take $\nu = 1 \times 10^{-6}\text{m}^2/\text{s}$ and $\rho = 1000\text{kg}/\text{m}^3$.
- b) What do you mean by boundary layer separation? What is the effect of pressure gradient on boundary layer separation? [5+5]

OR

- 11.a) Experiments were conducted in a wind tunnel with a wind speed of 50 km/hour on a flat plate of size 2 m long and 1 m wide. The density of air is $1.15\text{ kg}/\text{m}^3$. The coefficients of lift and drag are 0.75 and 0.15 respectively. Determine the lift force, the drag force, the resultant force, the direction of resultant force and the power exerted by the air on the plate.
- b) What is a boundary layer? Differentiate between a laminar and turbulent boundary layer. [5+5]

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