Code No: R2021013 **R20** SET - 1

II B. Tech I Semester Regular/Supplementary Examinations, January-2023
FLUID MECHANICS
(Civil Engineering)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions, each Question from each unit
All Questions carry **Equal** Marks
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UNIT-I

1 a) What do you mean by surface tension and capillarity? Find the surface tension of soap bubble of 40 mm diameter inside pressure is 2.5N/mm^2 above atmospheric pressure? [7M]

b) Define the centre of buoyancy, meta centre, and metacentric height. [7M]

OR

2 a) What is the difference between specific gravity, mass density and specific volume of fluid? If 5 m^3 of certain oil weighs 40kN, calculate the specific weight, mass density and specific gravity of this oil. [7M]

b) Prove that the centre of pressure of the completely submerged plain surface is always below the centre of gravity of the submerged surface or at most coincide with the centre of gravity when the plane is horizontal? [7M]

UNIT-II

3 a) Define local acceleration, convective acceleration and total acceleration. [7M]

b) If stream function, $\psi = (2x^3 - 3xy^2)$, indicate whether the flow is rotational or irrotational. If the flow is irrotational, determine the potential function. [7M]

OR

4 a) Define fluid. What is the Difference between i) steady flow and unsteady flow, ii) uniform and non-uniform flow, iii) compressible and incompressible. [7M]

b) Describe the use and limitations of flow nets.
Discuss the different methods of drawing the flow nets briefly. [7M]

UNIT-III

5 a) What power is required per km of a line to overcome the viscous resistance to the flow of glycerin through a horizontal pipe of diameter 100 mm @ 10 l/s? Take Dynamic viscosity as 8 poise and Kinematic viscosity as 6 stokes. [7M]

b) The rate of flow of water through a horizontal pipe is 0.25 m^3/s. The diameter of the pipe is suddenly enlarged from 100 mm to 150 mm. The pressure intensity in the small pipe is 15.2 N/cm^2. Determine the loss of head and power loss due to enlargement. [7M]

OR

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6	a)	Define viscosity and kinematic viscosity and velocity gradient, and pressure gradient?	[7M]
	b)	A horizontal venturi meter with inlet and throat diameters 200 mm and 100 mm, respectively, is used to measure the flow of water. The pressure intensity at the inlet is 100 kN/m^2, while the vacuum pressure head at the throat is 300 mm of mercury. Assuming that 2% of differential pressure head is lost between the inlet and the throat, determine the coefficient of discharge and discharge.	[7M]

UNIT-IV

7	a)	What is a mouthpiece? What are advantages of providing mouthpiece? Show that discharge of water through a sharp-edged orifice shall be increased by about 38% if a short cylindrical mouthpiece of the same diameter is fitted to it on the outside of the tank. Take the coefficient of contraction as 0.62 and neglect friction.	[7M]
	b)	Determine the discharge over a sharp crested weir 4.5m long with no end contractions, the measured head over the crest being 0.45m. The width of the approach channel is 7.5 m, and its depth below the crest of the weir is 1 m.	[7M]

OR

8	a)	Difference between large and small orifice. Obtain the expression for discharge through large rectangular orifice?	[7M]
	b)	What is a notch? How are they classified? Derive the expression for anyone one notch with a neat sketch?	[7M]

UNIT-V

9	a)	Define the displacement thickness and momentum thickness. Derive the expression for the displacement thickness?	[7M]
	b)	What is the difference between the laminar boundary layer and the turbulent boundary layer?	[7M]

OR

10	a)	What is the difference between preventing and separation of boundary layer?	[7M]
	b)	Calculate the friction drag on a plate 0.15 m wide and 0.45 m long placed longitudinally ina stream of oil flowing with a free stream velocity of 6 m/s. Also, find the thickness of the boundary layer and shear stress at the trailing edge. Sp. gr. of oil is 0.925 and its kinematic viscosity is 0.9×10^4 m^2/s (0.9 stokes)	[7M]

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FLUID MECHANICS

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UNIT-I

1 a) Explain the terms dynamic viscosity and kinematic viscosity give their dimensions? A certain liquid has a dynamic viscosity of 0.073 poise and specific gravity of 0.87. Compute the kinematic viscosity of the liquid in stokes and also in m^2/s. [7M]

b) Derive the expression for time period of oscillation of a floating body in terms of radius gyration and metacentric height of a floating body. [7M]

OR

2 a) Distinguish between ideal fluid and real fluid with examples? Explain the difference between the Newton's fluid and non-Newtonian fluid. [7M]

b) A flat circular plate, 1.2 diameter, is immersed in water such that its greatest and least depths are 1.50m and 0.60m, respectively. Determine: (i) The force exerted on one face by water pressure, (ii) The position of the centre of pressure. [7M]

UNIT-II

3 a) What is the Euler equation of motion? How will obtain Bernoulli's from it? [7M]

b) What is a stream tube, control volume, and circulation? The bucket of a spillway has a radius of 6 m. When the spillway discharges 5 cubic metres of water per second per metre length of crest, the average thickness of the sheet of water over the bucket is 0.4m. Compare the resulting normal acceleration (or centripetal acceleration) with the acceleration due to gravity. [7M]

OR

4 a) What is the difference between the momentum equation and the impulsive momentum equation? [7M]

b) The velocity components in the x and y– directions are given as $u = (2xy^3 - (2yx^3/3))$ and $v = xy^2 - (2yx^3/3))$. Indicate whether the given velocity distribution is a possible field of flow or not. [7M]

UNIT-III

5 a) Derive the expression for the velocity distribution and shear stress for viscose flow through a circular pipe across the section of pipe with a sketch. [7M]

b) Water flows from a reservoir through a pipe of 0.15 m in diameter and 180m long to a point13.5 m below the open surface of the reservoir. Here it branches into two pipes, each of 0.1 m diameter, one of which is 48 m long discharging to the atmosphere at a point 18m below reservoir level, and the other 60 m long discharging to the atmosphere 24 m below reservoir level. Assuming a constant friction coefficient of 0.032, calculate the discharge from each pipe. Neglect any losses at the junction. [7M]

OR

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6 a) Derive the expression for the loss of head due to friction in the pipes. [7M]

b) Show that the loss of head due to a sudden contraction in the pipeline is a function of velocity head. [7M]

UNIT-IV

7 a) a) Explain the following terms: (i) coefficient of velocity, (ii) coefficient of contraction and coefficient of discharge . [7M]

b) Derive the expression for $c_d = c_v \times c_c$

b) What is the difference between weir and notch? Explain the applications of weirs and notch with examples. [7M]

OR

8 a) Distinguish between i) external mouthpieces and internal mouthpieces ii) mouth running free, and mouth running full. [7M]

b) Venturi meter measures the flow of water in a 75 mm diameter pipe. The difference in head between the entrance and the throat of the venturi meter is measured by U-tube containing mercury, the space above the mercury on each side being filled with water. What should be the diameter of the throat of the meter in order that the difference of the levels of the mercury shall be 0.25 m when the quantity of water flowing in the pipe is 630 litres per minute? Assume the discharge coefficient as 0.97. [7M]

UNIT-V

9 a) Find the displacement thickness and momentum thickness for the velocity distribution in the boundary layer given by $u/U=(2(y/\delta)-(y/\delta)^2)$ [7M]

b) Define terms of boundary layer thickness and momentum thickness, drag and lift. [7M]

OR

10 a) Find the ratio of skin friction drag on the front half and rear half portions of a flat plate kept in a uniform stream of zero incidence. Assume the boundary layer to be turbulent over the entire plate. [7M]

b) Air flows over a flat plate 1 m long at a velocity of 6 m/s. Determine (i) the boundary layer thickness at the end of the plate, (ii) shear stress at the middle of the plate, (iii) total drag per unit length on the sidesof the plate. Take $\rho = 1.226$ kg/m^3 and $\upsilon = 0.15 \times 10^{-4}$ m^2/s for air. [7M]

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UNIT-I

1 a) State and prove Pascal's law and give some examples of this principle used. [7M]

b) Determine the total pressure and depth of the centre of pressure on a plain rectangular surface of 1 m wide and 3 m depth when its upper edge is horizontal and (i) coincide with the water surface (ii) 2 m below the free water surface ? [7M]

OR

2 a) What is a manometer? Explain how they are classified. [7M]

b) Derive the expression for meta-centric height of the floating body. [7M]

UNIT-II

3 a) a) Define stream function? Mention the properties of stream function? b) What is an equipotential line and flow net? [7M]

b) Explain the pitot static tube with a sketch. How do you determine the flow velocity at any point using a pitot static tube? [7M]

OR

4 a) Explain Bernoulli's equation and what are the assumption of Bernoulli's equation and mention the terms with a neat sketch. [7M]

b) What is the velocity stream function, and potential function. A stream function is given by $\Psi = 3x^2 - y^3$. Determine the magnitude of velocity components at the point (2, 1). [7M]

UNIT-III

5 a) What are the major and minor losses in the pipe flow? Explain the minor losses with a neat sketch. [7M]

b) Differentiate the following terms: (i) laminar flow and turbulent flow with examples (ii) total energy line and hydraulic gradient line [7M]

OR

6 a) Derive the expression for loss of head due to (i) Sudden enlargement (ii) Sudden contraction of the pipe [7M]

b) The water is flowing with a velocity of 1.5 m/s in apipe of length 2500 m and of diameter of 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 =14600m/s . [7M]

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UNIT-IV

7 a) Obtain an expression for time of emptying a circular horizontal tank. [7M]

b) What is the difference betweena venturi meter and an orifice meter? A Venturi meter is used for measuring the flow of petrol in a pipeline inclined at 35° to horizontal. The specific gravity of the petrol is 0.81, and the throat area ratio is 4. If the difference in mercury levels in the gage is 50 mm, calculate the flow in litres per hour if the pipe diameter is 0.3 m. Take the discharge coefficient of the venturi meter as 0.975. [7M]

OR

8 a) What is an orifice meter? Write the expression for discharge through orifice meter? An orifice of diameter 100mm is fitted at the bottom of a boiler drum of length 5m and of diameter 2m. The drum is horizontal and half full of water. Find the time required to empty the boiler, given the value of C_d=0.6 [7M]

b) Define vena contract? Explain how it's developed with a neat sketch. [7M]

UNIT-V

9 a) Derive the expression for boundary shear stress in terms of momentum thickness. [7M]

b) A smooth flat plate 1 m wide and 1.5 m long is rowed lengthwise through still air with a velocity of 10 m/s. Assuming the boundary layer to be fully laminar, estimate its thickness at the trailing edge. Mass density and kinematic viscosity of the air are 1.216 kg/m^3 and 0.15 ×10^{-4} m^2/s respectively. Also, calculate the shear stress at that point. [7M]

OR

10 a) What are the different methods for preventing boundary layer separation? [7M]

b) Find the ratio of skin friction drag on the front two-thirds and rear one-third of a flat platekept in a uniform stream at zero incidence. Assume the boundary layer to be turbulent over the entire plate. [7M]

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UNIT-I

1	a)	What is the difference between the absolute pressure, gauge pressure and vacuum pressure with a neat sketch?	[7M]
	b)	Distinguish between the manometers and mechanical gauges. Write a short note on different types of mechanical pressure gauges.	[7M]

OR

2	a)	Explain the neat sketch with the bourdon pressuregauge and its working principle.	[7M]
	b)	What is the simple manometer and inverted U tube manometers? How the pressure is, calculated using the manometers, explain the terms with a neat sketch?	[7M]

UNIT-II

3	a)	What is a Venturi meter and its application? Derive the expression for calculation of discharge in Venturi meter?	[7M]
	b)	Calculate the unknown velocity componentsso that they satisfy continuity equation: (a) $u = 2x^2$;$v = xyz$; $w = ?$ (b) $u = (2x^2 + 2xy)$;$w = (z^3 - 4xz - 2yz)$; $v = ?$	[7M]

OR

4	a)	Name the different types of forces acting on fluid flow. For the Euler equation what force is taken into consideration and why?	[7M]
	b)	What is the difference between streamline, path line and streak line?	[7M]

UNIT-III

5	a)	Explain the following terms and give one practical example for each (i)Laminar flow (ii) turbulent flow (iii) study flow and (iv) uniform flow	[7M]
	b)	Derive Darcy Weisbach equation for frictional losses in a pipe.	[7M]

OR

6	a)	Explain the terms (i) pipes in parallel (ii) pipes in series with a sketch and formulas for each conditions.	[7M]
	b)	Three pipes of different diameters and different lengths are connected in series to make a compound pipe.The end of the compound pipe connected with two tanks who's difference of levels is "h". If the coefficient of friction of the pipes are same, then derive the formula for total head loss neglecting the minor losses.	[7M]

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UNIT-IV

7 a) What is a Venturi meter? Derive an expression for discharge through venture meter [7M]

b) A rectangular notch has a crest length 1 m; the head over the notch is 0.2 m and the height of the sill above the bed level is 0.15 m. If the width of the channel is 1.2 m, calculate the discharge in cumec, taking into account the velocity of approach. [7M]

OR

8 a) Write a short note on the orifice.Two small identical orifices are located at the side of a tank filled to a water depth H. One orifice is located at a depth of h below the water surface and the other h above the tank bottom. Show that both the jets issuing from the orifices will strike the ground at the same distance from the orifice. Also, find this distance. [7M]

b) A pitot tube was used to measure the quantity of water flowing in a pipe of 0.3m diameter. The water was raised to a height of 0.25 m above the centre line of pipe in a vertical limb of the tube. If the mean velocity is 0.78 times the velocity at the centre and coefficient of pitot tube is 0.98, find the quantity of water in litres per second. Static pressure head at the centre of the pipe is 0.2 m. [7M]

UNIT-V

9 a) What do you mean by separation of boundary layer? What is the effect of pressure gradient on boundary layer separation? [7M]

b) Explain the characteristics of the laminar and turbulent boundary layer. For a linear velocity distribution in the boundary layer on a flat plate show that $(\delta^*/\theta) = 3$, and $(\delta E/\delta) = 0.25$. [7M]

OR

10 a) What are the methods of controlling boundary layer ? [7M]

b) If the velocity distribution in laminar boundary layer over a flat plate is assumed to be given by a polynomial $u=a+by+cy^2$, determine its form using the necessary boundary conditions. [7M]