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Hall Ticket Number:

CE211 (R20)

B.TECH. DEGREE EXAMINATION, DECEMBER-2024

Semester III [Second Year] (Regular & Supplementary)

FLUID MECHANICS

Time: Three hours | Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)
Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:

(a)	Define metacentric height.		CO1
(b)	Define centre of pressure.		CO1
(c)	Define specific gravity.		CO1
(d)	What is a flownet?		CO2
(e)	Define Streak line.		CO2
(f)	Define velocity potential function.		CO2
(g)	What is velocity of approach?		CO3
(h)	Classify different types of orifices.		CO3
(i)	What is end contractions?		CO3
(j)	What are the characteristics of turbulent flow?		CO4
(k)	What is an equivalent pipe?		CO4
(l)	Define total energy line.		CO4
(m)	Write the expression for minor loss due to sudden expansion in pipe?		CO4
(n)	What is water hammer?		CO4

UNIT – I

2. (a) Derive an equation for centre of pressure of an inclined plane surface submerges in a liquid. (7M) CO1

(b) A simple U-tube manometer containing mercury is connected to a pipe in which an oil of specific gravity 0.8 is flowing. The pressure in the pipe is vacuum. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 200 mm and height of oil in the left limb from the centre of the pipe is 150 mm below. (7M) CO1

(OR)

3. (a) Explain briefly different types of equilibrium of floating bodies. (7M) CO1
   (b) Determine the total pressure and centre of pressure on an isosceles triangular plate of base 4 m and altitude 4 m when immersed vertically in an oil of specific gravity 0.9. The base of the plate coincides with the free surface of oil. (7M) CO1

UNIT – II

4. (a) Derive Bernoulli's equation. (7M) CO2
   (b) The velocity components in a two dimensional flow field for an incompressible fluid are as follows: $u = \frac{y^3}{3} + 2x - x^2y$, $v = xy^2 - 2y - \frac{x^3}{3}$. Obtain an expression for stream function. (7M) CO2

(OR)

5. (a) Define total acceleration, convective acceleration and local acceleration. (6M) CO2
   (b) Differentiate between rotational and irrotational, uniform and non-uniform flows and laminar and turbulent flows. (8M) CO2

UNIT – III

6. (a) Define coefficient of contraction, coefficient of velocity and coefficient of discharge. (6M) CO3
   (b) Find the discharge through a trapezoidal notch which is 1 m wide at the top and 0.4 m at the bottom and is 30 cm in height. The head of water on the notch is 20 cm. Assume C_d for rectangular portion as 0.62 while for triangular portion as 0.6. (8M) CO3

(OR)

7. (a) Derive the expression for discharge through a broad crested weir. (7M) CO3
   (b) Differentiate between an orificemeter and a venturimeter. Derive the expression for discharge through an orificemeter. (7M) CO3

UNIT – IV

8. (a) Derive Hagen Poiseuille equation. (7M) CO4
   (b) A pipe line 0.225 m in diameter and 1580 m long has a slope of 1 in 200 for the first 790 m and 1 in 100 for the next 790 m. The pressure at the upper end of the pipeline is 107.91 kPa and at the lower end is 53.955 kPa. Taking f = 0.032, determine the discharge through pipe. (7M) CO4

(OR)

9. (a) Derive Darcy-weisbach equation. (7M) CO4
   (b) What are hydrodynamically smooth and rough boundaries? Explain in detail. (7M) CO4

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(b) A piping system consists of three pipes arranged in series: the lengths of the pipes are 1200 m, 750 m and 600 m and diameters 750 mm, 600 mm and 450 mm respectively. (7M) CO4

(i) Transform the system to an equivalent 450 mm diameter pipe and

(ii) Determine an equivalent diameter for the pipe, 2550 m long.

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Hall Ticket Number:

CE211 (R20)

B.TECH. DEGREE EXAMINATION, APRIL-2024

Semester III [Second Year] (Supplementary)

FLUID MECHANICS

Time: Three hours Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)
Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:
   (a) Explain about dynamic viscosity. CO1
   (b) State Pascal's law. CO1
   (c) Define gauge pressure. CO1
   (d) What is metacentre? CO1
   (e) Illustrate the forces acting on Euler's equation of motion. CO2
   (f) Explain the term kinetic energy correction factor. CO2
   (g) What is velocity potential function? CO2
   (h) Classify the types of Pitot tubes? CO3
   (i) Define velocity of approach. CO3
   (j) What are the types of orifices? CO3
   (k) What is the relation between coefficient of contraction, coefficient of discharge and coefficient of velocity? CO3
   (l) Mention any two laws of fluid friction. CO4
   (m) Define total energy line. CO4
   (n) Write an expression for Hagen-Poiseuille equation. CO4

UNIT – I

2. (a) Categorize the types of fluids with the help of variation of shear stress with velocity gradient. (7M) CO1
   (b) A plate 0.05 mm distant from a fixed plate moves at 1.2 m/s and requires a force of 2.2 N/m^2 to maintain this speed. Find the viscosity of the fluid between the plates. (7M) CO1

(OR)

3. (a) Derive an expression for total pressure and centre of pressure for a plane lamina immersed in a liquid which makes an angle θ with the horizontal. (7M) CO1
   (b) A metallic cube 30 cm side and weighing 450 N is lowered into a tank containing a two-fluid layer of water and mercury. Determine the position of block at mercury-water interface when it has reached equilibrium. (7M) CO1

UNIT – II

4. (a) Derive an expression for Energy equation using Euler's equation of motion. (7M) CO2
   (b) A conical pipe diverges uniformly from 100 mm to 200 mm diameter over a length of 1 m. Determine the local and convective acceleration at the mid-section assuming rate of flow is 0.12 m^3/s and it remain constant. (7M) CO2

(OR)

5. (a) Derive an expression for Laplace equation using velocity potential function and Poisson's equation using stream function. (7M) CO2
   (b) 360 litres per second of water is flowing in a pipe. The pipe is bent by 120^0. The pipe bend measures 360 mm x 240 mm and volume of the bend is 0.14 m^3. The pressure at the entrance is 72 kN/m^2 and the exit is 2.4 m above the entrance section. Find the force exerted on the bend. (7M) CO2

UNIT – III

6. (a) Derive an expression for discharge through rectangular notch. (7M) CO3
   (b) A rectangular orifice 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 $C_d = 0.62$. (7M) CO3

(OR)

7. (a) Derive an expression for discharge through orificemeter. (7M) CO3
   (b) A 1 m diameter circular tank contains water upto a height of 4 m. At the bottom of tank an orifice of 40 mm is provided. Find the height of water above the orifice after 1.5 minutes. (7M) CO3

UNIT – IV

8. (a) Define equivalent pipe. Derive an expression for Dupit's equation. (7M) CO4
   (b) The diameter of a horizontal pipe which is 300 mm is suddenly enlarged to 600 mm. The rate of flow of water through this pipe is 0.4 m^3/s. If the intensity of pressure in the smaller pipe is 125 kN/m^2, determine: (7M) CO4
      (i) Loss of head, due to sudden enlargement.
      (ii) Intensity of pressure in the larger pipe.

(OR)

9. (a) Write a short note on minor losses and derive an expression for loss of head due to sudden enlargement. (7M) CO4

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Hall Ticket Number:

CE211 (R20)

B.TECH. DEGREE EXAMINATION, DECEMBER-2023

Semester III [Second Year] (Regular & Supplementary)

FLUID MECHANICS

Time: Three hours | Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)
Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:
   (a) How does viscosity vary with temperature in liquids? CO1
   (b) Define vapour pressure. CO1
   (c) Define Buoyancy. CO1
   (d) Differentiate between rotational and irrotational flows. CO2
   (e) Define path line. CO2
   (f) Mention the assumptions made in deriving Bernoulli's equation. CO2
   (g) Define Vena contracta. CO3
   (h) What is a pitot tube? CO3
   (i) What are the advantages of a triangular notch over a rectangular notch? CO3
   (j) What is syphon? Where is it used? CO4
   (k) What are laws of fluid friction? CO4
   (l) Differentiate between a laminar flow and a turbulent flow. CO4
   (m) Write Hagen Poiseuille equation. CO4
   (n) What are the effects of cavitation in pipes? CO4

UNIT – I

2. (a) Define surface tension. Derive expression for the pressure (i) within a droplet of water (ii) inside a soap bubble. (7M) CO1

(b) A rectangular plane surface 2 m wide and 3 m deep lies in water in such a way that its plane makes an angle of 30^0 with the free surface of water. Determine the total pressure and position of centre of pressure when the upper edge is 1.5 m below the free surface? (7M) CO1

(OR)

3. (a) State and prove Pascal's law. (7M) CO1
   (b) An oil of viscosity 5 poise is used for lubrication between a shaft and sleeve. The diameter of the shaft is 0.5 m and it rotates at 200 rpm. Calculate the power lost in oil for a sleeve length of 100 mm. The thickness of oil film is 1.0 mm. (7M) CO1

UNIT – II

4. (a) Explain steady and unsteady flow, uniform and non-uniform flow, rotational and irrotational flow. (7M) CO2
   (b) A 45^0 reducing bend is connected in a pipe line, the diameters at the inlet and outlet of the bend being 600 mm and 300 mm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet to bend is 8.829 N/cm^2 and rate of flow of water is 600 liters/s. (7M) CO2

(OR)

5. (a) Derive Continuity equation in three dimensional cartesian coordinate system. (7M) CO2
   (b) The velocity potential function is given by an expression $\phi = x^2 - y^2$. Find the velocity components in x and y direction and show that ϕ represents a possible case of flow? (7M) CO2

UNIT – III

6. (a) Derive the expression for discharge through a Venturimeter. (7M) CO3
   (b) The head of water over an orifice of diameter 100 mm is 10 m. The water coming out from orifice is collected in a circular tank of diameter 1.5 m. The rise of water level in this tank is 1.0 m in 25 seconds. Also the coordinates of a point on the jet, measured from vena-contracta are 4.3 m horizontal and 0.5 m vertical. Find the coefficients C_d, C_c and C_v? (7M) CO3

(OR)

7. (a) Differentiate between orifice and a mouthpiece. Classify different types of mouthpieces. (7M) CO3
   (b) Derive the expression for discharge through a triangular notch. (7M) CO3

UNIT – IV

8. (a) Explain about Reynold's experiment to determine type of flow. (7M) CO4
   (b) Three pipes of diameter 300 mm, 200 mm and 400 mm and lengths 450 m, 255 m and 315 m respectively are connected in series. The difference in water surface levels in two tanks is 18 m. Determine the rate of flow of water, if coefficient of friction are 0.0075, 0.0078 and 0.0072 respectively neglecting minor losses. (7M) CO4

(OR)

9. (a) Define and explain the terms Hydraulic Gradient Line and Total Energy Line. (7M) CO4
   (b) Explain the variation of friction factor with Reynold's number. (7M) CO4

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(b) A viscous flow is taking place in a pipe of diameter 100 mm. The maximum velocity is 2 m/s. Determine the mean velocity and also estimate the velocity at 30 mm from the wall of the pipe. (7M) CO4

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CE211 (R20)

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Hall Ticket Number:

CE211 (R20)

B.TECH. DEGREE EXAMINATION, JUNE-2023

Semester III [Second Year] (Supplementary)

FLUID MECHANICS

Time: Three hours Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)
Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:
   (a) What is capillarity? CO1
   (b) When inverted U-tube manometers are to be used? CO1
   (c) What is the condition of stable equilibrium of a sub-merged body? CO1
   (d) What are the properties of a velocity potential function? CO1
   (e) Define streak line. CO2
   (f) List out any two assumptions while deriving Bernoulli's equation. CO2
   (g) Name the device which is used for measuring the velocity of a flow in open channel. CO3
   (h) Write the discharge equation through a Borda's mouth piece under running free flow case. CO3
   (i) Define velocity of approach. CO3
   (j) Determine the % error in discharge through a triangular notch while the % error in measuring head is 2. CO3
   (k) Determine the maximum velocity in a laminar pipe flow if the average velocity is 2 m/s. CO4
   (l) Define Hydraulic gradient line. CO4
   (m) Write the expression for finding head loss due to sudden expansion of the pipe. CO4
   (n) What is the relation between friction factor and Reynold's number in case of laminar flow? CO4

UNIT – I

2. (a) Define and derive Pascal's law. (7M) CO1
   (b) Determine the kinematic viscosity of an oil having density 950 kg/m^3, when at a certain point in the oil, the shear stress is 0.25 N/m^2 and velocity gradient is 0.5/sec. (7M) CO1

(OR)

3. (a) Derive the expression for finding the pressure difference head at two points in horizontal pipe carrying water by mercury differential U-tube manometer. (7M) CO1
   (b) Determine the capillary rise in a glass tube of 5 mm diameter when immersed vertically in (i) water (ii) mercury. Take surface tensions for mercury and water as 0.0725 N/m and 052 N/m respectively. (7M) CO1

UNIT – II

4. (a) Derive Bernoulli's expression. (7M) CO2
   (b) A pipe of diameter 500 mm carries water at a velocity of 25 m/s. The pressures at the points A and B are given as 30 N/cm^2 and 20 N/cm^2 respectively while the datum head at A and B are 25 m 30 m. Estimate the loss of head between A and B. (7M) CO2

(OR)

5. (a) Explain stream function & velocity potential function and express the relation between them. (7M) CO2
   (b) For a two-dimensional potential flow, the velocity potential is given by $\phi = x(2y - 1)$. Determine the corresponding stream function ψ. (7M) CO2

UNIT – III

6. (a) What is a mouth piece and derive the expression for discharge through an external mouth piece? (7M) CO3
   (b) A rectangular orifice 1 m wide and 1 m deep is discharging water from a vessel. The top edge of the orifice is 0.8 m below the water surface in the vessel. Determine the discharge through the orifice if C_d = 0.6. Also determine the percentage error if the orifice is treated as a small orifice. (7M) CO3

(OR)

7. (a) Derive the discharge equation through a trapezoidal notch. (7M) CO3
   (b) A rectangular channel 2 m wide has a discharge of 200 liters/sec, which is measured by a right angled triangular weir. Assess the position of the apex of the weir from the bed of the channel, if maximum depth of water is not to exceed 1 m. Take C_d = 0.62. (7M) CO3

UNIT – IV

8. (a) Derive Darcy's weisbach equation for finding loss of head due to friction. (7M) CO4
   (b) An oil of kinematic viscosity 0.5 stoke is flowing through a pipe of diameter 500 mm at the rate of 300 liters/sec. Determine the head lost due to friction for a length of 50 m of the pipe. (7M) CO4

(OR)

9. (a) Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow. (7M) CO4

(b) Three pipes of lengths 500 m, 400 m and 300 m and of diameters 0.5 m, 0.4 m and 0.3 m respectively are connected in series. The ends of the pipe is connected to two tanks, whose water surface levels are maintained at a difference of 10 m. Determine the rate of flow of water through the pipes if coefficient of friction is 0.005. (8M) CO4

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Hall Ticket Number:

CE211 (R20)

B.TECH. DEGREE EXAMINATION, MARCH-2023

Semester III [Second Year] (Regular & Supplementary)

FLUID MECHANICS

Time: Three hours Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)
Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:
   (a) Define vapour pressure. CO1
   (b) Determine the pressure of water at a depth of 20 m below the water surface. CO1
   (c) What is the condition for stable equilibrium of floating body? CO1
   (d) What are the properties of a stream function? CO2
   (e) Write the expression of acceleration in 3D-flow along x-direction. CO2
   (f) What are the forces considered while deriving Euler's equation of motion? CO2
   (g) Why coefficient of discharge is more for Venturimeter when compared to orifice meter? CO3
   (h) Find coefficient of discharge of the orifice, if coefficient of velocity is 0.95 and coefficient of contraction is 0.62. CO3
   (i) Write the discharge equation through a Cipolletti weir. CO3
   (j) What is narrow crested weir? CO3
   (k) Determine the Reynold's number when water is flowing in a pipe of 0.3 m diameter with a velocity 5 m/s having viscosity 0.02 Pa-s. CO4
   (l) What is an equivalent pipe? CO4
   (m) Find the friction factor of the pipe, if the Reynold's number of the flow is 1500. CO4
   (n) What is the function of a siphon? CO4

UNIT – I

2. (a) Define and explain Newton's law of viscosity. (6M) CO1
   (b) A circular plate 3 m diameter is immersed in water in such a way that the plane of the plate makes an angle of 60^{o} with the free surface of the water. Determine the total pressure and position of centre of pressure when the upper edge of the plate is 2 m below the free water surface. (8M) CO1

(OR)

3. (a) Prove that the position of centre of pressure of a completely sub-merged plane surface is always below the centre of gravity of the plane surface when it is submerged in vertical. (7M) CO1
   (b) A block of wood of specific gravity 0.8 floats in water. Determine the meta-centric height of the block if its size is 3 m x 2 m x 1 m. (7M) CO1

UNIT – II

4. (a) Derive Euler's equation of motion. (7M) CO2
   (b) Water is flowing through a taper pipe of length 100 m having diameters 0.6 m at the upper end and 0.3 m at the lower end, at a rate of 50 litres/sec. The pipe is laid at a slope of 1 in 30. Determine the pressure at the lower end if the pressure at the higher end is 20 N/cm^2. (7M) CO2

(OR)

5. (a) Derive the continuity equation for three dimensional flows. (7M) CO2
   (b) A fluid flow field is given by $V = x^2y\,i + y^2z\,j - (2xyz + yz^2)\,k$ prove that it is a case of possible steady incompressible fluid flow. Assess the velocity at a point (2, 3, 4). (7M) CO2

UNIT – III

6. (a) What is Venturimeter? Derive the expression for the discharge through Venturimeter. (7M) CO3
   (b) A circular tank of diameter 3 m contains water up to a height of 4 m. The tank is provided with an orifice of diameter 0.4 m at the bottom. Determine the time taken by water (i) To fall from 4 m to 1 m (ii) For completely empty the tank. Take $C_d = 0.6$. (7M) CO3

(OR)

7. (a) Derive the expression for the discharge through Cipolletti weir. (7M) CO3
   (b) A right angled V-Notch is used for measuring the discharge of 30 litres/s. An error of 3 mm was made in measuring the head over the notch. Determine the percentage error in the discharge. Take C_d as 0.62. (7M) CO3

UNIT – IV

8. (a) Derive an expression for loss of head of a viscous fluid flowing through a circular pipe (Hazen poiseuille's equation). (7M) CO4
   (b) A fluid of viscosity 0.6 poise and specific gravity 1.2 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 150 N/m^2, determine (i) Pressure gradient (ii) Reynold's number of the flow. (7M) CO4

(OR)

9. (a) Define and explain the terms: (6M) CO4
   (i) Hydraulic gradient line
   (ii) Total energy line.