

B.E. / B.Tech.- DEGREE EXAMINATIONS, NOV / DEC 2025
 Third Semester
Civil Engineering
24CEPC302 - FLUID MECHANICS AND HYDRAULIC ENGINEERING
 Regulations - 2024

Duration: 3 Hours

Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

	<i>Marks</i>	<i>K- Level</i>	<i>CO</i>
1. The specific gravity of a fluid is defined as:	1	K1	CO1
(a) Weight per unit volume of fluid			
(b) Ratio of fluid density to density of water			
(c) Ratio of mass to volume			
(d) Ratio of weight to volume			
2. The total pressure on a plane surface immersed in a liquid act at:	1	K1	CO1
(a) Centroid of the area			
(b) Center of pressure			
(c) Free surface			
(d) Top surface			
3. A streamline is a line which:	1	K1	CO2
(a) Is drawn normal to velocity vector			
(b) Is parallel to velocity vector			
(c) Joins points of equal pressure			
(d) Joins points of equal potential			
4. Bernoulli's equation is applicable for:	1	K1	CO2
(a) Steady, incompressible, and non-viscous flow			
(b) Unsteady flow only			
(c) Compressible flow with viscosity			
(d) Rotational flow			
5. For laminar flow in a circular pipe, the friction factor (f) is given by:	1	K1	CO3
(a) $f = \frac{16}{Re}$			
(b) $f = \frac{64}{Re}$			
(c) $f = \frac{24}{Re}$			
(d) $f = \frac{32}{Re}$			
6. The head loss due to friction is directly proportional to:	1	K1	CO3
(a) Velocity			
(b) Square of Velocity			
(c) Pipe diameter			
(d) Square root of velocity			
7. Open channel flow is primarily driven by:	1	K1	CO4
(a) Pressure gradient			
(b) Gravity			
(c) Viscosity			
(d) Pumping			
8. The critical depth in a rectangular channel occurs when:	1	K1	CO4
(a) Specific energy is maximum			
(b) Specific energy is minimum			
(c) Froude number = 1			
(d) Velocity = 0			
9. Positive surge occurs when:	1	K1	CO5
(a) Water level rises suddenly			
(b) Water level falls suddenly			
(c) Flow becomes laminar			
(d) Flow becomes uniform			
10. Kaplan turbine is classified as:	1	K1	CO6
(a) Impulse turbine			
(b) Reaction turbine			
(c) Mixed flow turbine			
(d) Reciprocating turbine			

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11. State Pascal's Law.	2	K1	CO1
12. Why do we use mercury in the manometer while measuring the pressure of fluid?	2	K2	CO1
13. Define fluid kinematics and differentiate it from fluid dynamics.	2	K2	CO2
14. What is a flow net? Give its importance	2	K1	CO2
15. What are major and minor energy losses in pipe flow? Give examples of each.	2	K1	CO3
16. Differentiate laminar flow and turbulent flow.	2	K2	CO3
17. What are best hydraulic sections for uniform flow? Why circular and rectangular sections are commonly used.	2	K2	CO4
18. Compare the pipes in series verses pipes in parallel.	2	K2	CO4
19. Define pipe flow and open channel flow. State the key differences between them.	2	K2	CO5

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| 20. Classify hydraulic jump based on Froude's number. | 2 | K2 | CO5 |
| 21. Define negative slip and when it will occur in reciprocating pump? | 2 | K1 | CO6 |
| 22. Define specific speed of a turbine. | 2 | K1 | CO6 |

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

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| 23. a) (i) A vertical gate of width 3 m and height 2 m is submerged in water with its top edge at the water surface. Find: (a) Total pressure force on the gate (b) Depth of the center of pressure. | 6 | K3 | CO1 |
| (ii) A liquid has a mass of 540 kg and occupies a volume of 0.45 m ³ . Find: (a) Density (ρ) (b) Specific weight (γ) (Take $g = 9.81 \text{ m/s}^2$) | 5 | K3 | CO1 |
| OR | | | |
| b) (i) A glass tube of 1.2 mm internal diameter is inserted vertically in water. Find the capillary rise. (Take surface tension $\sigma = 0.073 \text{ N/m}$, $\theta = 0^\circ$, $\rho = 1000 \text{ kg/m}^3$, $g = 9.81 \text{ m/s}^2$) | 6 | K3 | CO1 |
| (ii) Two horizontal plates are spaced 2 mm apart. The lower plate is stationary, and the upper plate moves with a velocity of 1.2 m/s. Find the viscosity of the fluid if the shear stress is 1.8 N/m ² . | 5 | K3 | CO1 |
| 24. a) A pipe line carrying oil of specific gravity 0.87, changes in diameter from 200mm at position A to 500mm at position B, which is 4m at higher level. If the pressures at A and B are 9.81 N/cm ² and 5.886 N/cm ² respectively and the discharge is 200lps. Determine the loss of head and direction of flow. | 11 | K3 | CO2 |
| OR | | | |
| b) If for a two-dimensional potential flow, the velocity potential function 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. | 11 | K3 | CO2 |
| 25. a) Determine the head lost due to friction in a pipe of diameter 350mm and of length 70m, through which water is flowing at a velocity of 6 m/s using (i) Darcy's Weisbach formula, (ii) Chezy's formula for which $C = 50$. | 11 | K3 | CO3 |
| OR | | | |
| b) A pipe line of 0.65 m diameter is 1.60 km long. To increase the discharge another line of the same diameter is introduced parallel to the first in the second half of the length. Neglecting minor losses, analyse the increase in discharge if $4f=0.04$. The head at inlet is 300 mm. | 11 | K3 | CO3 |
| 26. a) A trapezoidal channel with side slopes 1 to 1 has to be designed to carry 20m ³ /s at a velocity of 2.6 m/s so that the amount of lining of concrete for bed and sides is minimum. Calculate the area of lining required for one-meter length of the channel. | 11 | K3 | CO4 |
| OR | | | |
| b) How the flows are classified under specific energy concepts? Find the discharge through a rectangular channel of width 6m, having a bed slope of 1 in 1000. The depth of flow is 4m. Use Chezy's formula, Take $C=50$. | 11 | K3 | CO4 |
| 27. a) Determine the slope of the free water surface in a rectangular channel of width 25m, having depth of flow 6m. The discharge through the channel is 65 cumecs. The bed slope of the channel is 1 in 4200. Assume Chezy's constant C as 60. | 11 | K3 | CO5 |
| OR | | | |
| b) A rectangular channel 8 m wide discharge 1500 litres/sec of water into a 8m wide apron with no slope and with a mean velocity of 7 m/s. what is the height of the jump? How much energy is absorbed in the jump? Comment your result. | 11 | K3 | CO5 |

28. a) A Kaplan turbine develops 20,000Kw at a head of 36m and at a rotational speed of 440rpm. The outer diameter of the blades is 2.8m and the hub diameter is 0.88m. If the overall efficiency is 86% and the hydraulic efficiency is 89%, calculate the discharge, the inlet flow angle and the blade at the inlet. 11 K3 CO6

OR

- b) A single acting reciprocating pump running at 60 rpm delivers water at a rate of 0.02m³ /sec. The diameter of the piston(D) is 210mm and stroke length L=420mm. Determine theoretical discharge of the pump, coefficient of discharge, slip and % slip of the pump and power required to drive the pump if $h_s=26m$ and $h_d=32m$. 11 K3 CO6