

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

Third Semester

Civil Engineering

20CEPC303 - FLUID MECHANICS

Regulations - 2020

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 weight of fluid having specific gravity 0.88 is (a) 8532 N/m ³ (b) 8632 N/m ³ (c) 8732 N/m ³ (d) 8832 N/m ³	1	K3	CO1
2. Types of Mechanical Gauges are (a) Bourdon Tube Pressure Gauge (b) Diaphragm Pressure Gauge (c) Bellow's Pressure Gauge (d) All of the above	1	K1	CO1
3. The Centre of Pressure (CP) always lies (a) Below Centre of Gravity (b) Coincides with Centre of Gravity (c) Above Centre of Gravity (d) None of the above	1	K1	CO2
4. For stable equilibrium, the Meta Centre should be (a) Positive (b) Negative (c) Both a and b (d) Neither a nor b	1	K1	CO2
5. In a steady flow, the flow characteristics are (a) change with respect to time (b) does not change with respect to time (c) change with respect to space (d) does not change with respect to space	1	K1	CO3
6. Venturimeter is used to measure (a) Velocity (b) Discharge (c) Both a and b (d) None of the above	1	K1	CO3
7. Uses of dimension analysis (a) It helps in testing the dimensional homogeneity of any equation of fluid motion (b) It helps in deriving equations expressed in terms of non-dimensional parameters (c) It helps in planning model tests and presenting experimental results in a systematic manner (d) All of the above	1	K1	CO4
8. Reynolds's Model Law is applicable for (a) Fully submerged flow over a body (b) Design of aeroplanes (c) Design of submarines and submerged bodies (d) All of the above	1	K1	CO5
9. The single pipe replacing the compound pipe without change in discharge and head loss is known as (a) Pipes in Series (b) Pipes in Parallel (c) Equivalent Pipe (d) None of the Above	1	K1	CO6
10. The Boundary Layer Effect will continue up to (a) Free Stream Velocity (b) 0.99 times Free Stream Velocity (c) Laminar Boundary Layer (d) Turbulent Boundary Layer	1	K1	CO6

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11. Calculate the capillary rise in 'mm' in a glass tube of 5 mm diameter, when immersed in mercury. The value of surface tension of mercury in contact with air is 0.505 N/m.	2	K2	CO1
12. Draw the graphical representation of types of pressure.	2	K2	CO1
13. What is meant by total pressure and centre of pressure?	2	K1	CO2
14. Define: Buoyant Force.	2	K1	CO2
15. If $u = 4x - 6y + z$, $v = 3x - 5y + 2z$ and $w = x - 4y + kz$, compute the value of k for the possible flow.	2	K2	CO3
16. State impulse momentum equation.	2	K1	CO3

17. Check the dimensional homogeneity of the following common equation in the field of hydraulics: $Q = C_d A \sqrt{2gh}$. 2 K2 CO4
18. Differentiate undistorted and distorted models. 2 K2 CO4
19. The compound pipe having diameters 200 mm, 150 mm & 300 mm with lengths 100 m, 250 m & 120 m has to be replaced by single pipe. Determine the equivalent diameter of pipe. 2 K2 CO5
20. What is meant by Moody's chart and what are the uses of Moody's chart? 2 K2 CO5
21. Draw the various boundary layer zones in a flow over the flat plate. 2 K2 CO6
22. List out the few methods used to prevent the separation of boundary layer. 2 K2 CO6

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23. a) A shaft having diameter 30 cm is inserted on a hollow sleeve of length 1000 mm having inner and outer diameter 30.4 cm and 32 cm respectively. The gap between the shaft and sleeve is filled with an oil of viscosity 23.4 poise. If the shaft rotates at 65 rpm, determine the power required to maintain the shaft at the given speed. Also calculate the Torque developed in the shaft. 11 K3 CO1

OR

- b) Calculate the capillary rise in a glass tube of 2.5 mm diameter when immersed vertically in (a) water and (b) mercury. Take surface tension $\sigma = 0.0725$ N/m for water and $\sigma = 0.52$ N/m for mercury in contact with air. The specific gravity for mercury is given as 13.6 and angle of contact = 130° 11 K3 CO1
24. a) An opening in a dam is covered by the use of vertical sluice gate. The opening is 2 m wide and 1.2 m high. On the upstream side of the gate the liquid having specific gravity 1.45 lies up to a height 1.5 m above the top of gate, whereas on the downstream side the water is available up to a height touching the top of the gate. Find:
 (i) The resultant force acting on the gate and position of the centre of pressure.
 (ii) The force acting horizontally at the top of gate which is capable of opening the gate.
 Assume that gate is hinged at the bottom. 11 K3 CO2

OR

- b) A solid cylinder of 3.0 m diameter and height 6 m is floating in oil of specific gravity 0.9 with its axis vertical. Find the Metacentric height of the cylinder if specific gravity of the cylinder material is 0.58. Comment about the equilibrium status of the floating cylinder. 11 K3 CO2
25. a) In a two dimensional incompressible flow, the fluid velocity components are given by $u = \frac{y^3}{3} + 2x - x^2y$; $v = xy^2 - \frac{x^3}{3} - 2y$. Show that the flow is continuous. Also determine the velocity potential and stream function. 11 K3 CO3

OR

- b) Derive the Euler's equation of motion for steady flow of an ideal fluid. Using Euler's equation, derive the Bernoulli's equation. 11 K3 CO3
26. a) A spillway model is to be built to a scale ratio of 1:40 across a flume of 600 mm width. The prototype is 10 m high and the maximum head expected is 1.5 m.
 (i) Find the height of the model and head on the model.
 (ii) Find the flow over prototype when the flow over the model is 12 lps.
 (iii) If a negative pressure of 0.15 m occurs in the model, what will be the negative pressure in the prototype? 11 K3 CO4

OR

- b) The pressure difference (Δp) in a pipe of diameter (D) and length (l) due to viscous flow depends on the velocity (v), viscosity (μ) and density (ρ). Using Buckingham's π theorem, obtain the expression for the pressure difference (Δp). 11 K3 CO4

27. a) Derive the Hagen Poiseuille's formula for a viscous flow through a circular pipe. 11 K3 CO5

OR

- b) Water is transmitted from a reservoir using a compound pipe of diameter 250 mm, 200 mm and 300 mm having lengths 500 m, 200 m and 200 m with coefficient friction 0.004 respectively. The difference of water level between inlet and outlet is 30 m. Determine the discharge for the following cases: 11 K3 CO5
(i) Considering major loss alone
(ii) Consider both major and minor energy losses

28. a) Find the momentum thickness and the energy thickness for the velocity distribution in the boundary layer given by 11 K3 CO6

$$u = \left(\frac{3y}{2\delta} - \frac{y^2}{2\delta^2} \right)$$

OR

- b) A flat plate of length 1m and 400 mm width has been placed longitudinally in a stream of oil which flows with a velocity of 5 m/s. The specific gravity of oil is 0.85 and viscosity is 1.5 poise. 11 K3 CO6
Calculate:
(i) Boundary layer thickness
(ii) Shear stress at the middle of plate
(iii) Friction drag on both sides of the plates.