Reg. No.																

Question Paper Code	13208

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

Third Semester

Civil Engineering

20CEPC303 - FLUID MECHANICS

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	Who is the father of fluid mechanics? (a) Blaise Pascal (b) Leonardo da Vinci (c) Ludwig Prandtl (d) Satish Dhawan	1	K1	CO1
2.	On increasing the temperature of a fluid, the viscosity of the liquid _____ (a) Remains constant (b) First decreases and then increases (c) Increases (d) Decreases	1	K2	CO1
3.	Surface tension for an ideal fluid is _____ (a) Unity (b) Zero (c) Infinity (d) Depends on temperature	1	K1	CO1
4.	Which one of the following pressure units represents the maximum pressure? (a) Millibar (b) mm of Hg (c) N/mm^2 (d) kgf/cm^2	1	K1	CO2
5.	A small difference between two points along a pipeline carrying water is to be measured using a U – tube manometer. The manometric fluid to be used is _____ (a) Mercury (b) Water (c) Carbon tetrachloride (d) Kerosene	1	K2	CO2
6.	What will be the centre of buoyancy of a block horizontally in water? The dimensions of the block are 5 x 2 x 1m and the specific gravity of the block is 0.65. (a) 0.27 (b) 0.32 (c) 0.45 (d) 0.55	1	K2	CO2
7.	Match List I with List II and select the correct answer using the codes given below the lists:	1	K2	CO3

List I	List II
A. Steady flow	1. Condition do not change with time at any point
B. Uniform flow	2. Only convective acceleration
C. Irrotational flow	3. The spatial rate of change of velocity is zero
D. Converging steady flow	4. Zero circulation

(a) A-1, B-3, C-4, D-2 (b) A-1, B-2, C-3, D-4
(c) A-1, B-3, C-2, D-4 (d) A-3, B-1, C-4, D-2

8.	Which section of venturimeter is prone to flow separation? (a) diverging section (b) throat section (c) converging section (d) all of the above	1	K2	CO3
9.	The coefficient of discharge, c_d in terms of c_v and c_c is (a) $c_d = c_v + c_c$ (b) $c_d = c_v \times c_c$ (c) $c_d = c_v/c_c$ (d) none of these	1	K1	CO3
10.	Froude's number is the square root of ratio of inertia force to ____ (a) gravity force (b) pressure force (c) surface tension force (d) viscous force	1	K1	CO4
11.	Statement I: When variables are few, then Rayleigh's methods is used in dimensional analysis Statement II: When variables are more, then Buckingham π method is used, since the Rayleigh's method becomes cumbersome in dimensional analysis (a) Statement I is true, but statement II is false (b) Statement I is false, but statement II is true (c) Both statement I and statement II are individually true and statement II is the correct explanation of statement I (d) Both statement I and statement II are individually true but statement II is the not the correct explanation of statement I	1	K2	CO4

12. Which of the following is not correct? *1 K2 CO4*
(a) Reynolds model law is applicable for flow around submarines
(b) Froude's model law is applicable for flow of jet from an orifice
(c) Froude's model law is applicable, when gravity forces are predominant in addition to inertial force
(d) Weber model law is applicable, where phenomenon of cavitation takes place

13. The loss of head in a pipe carrying turbulent flow varies _____ *1 K2 CO5*
(a) Directly as the velocity of flow
(b) Directly as the square of the velocity of flow
(c) Inversely as the square of the velocity of flow
(d) Inversely as the square of the diameter of pipe

14. For a steady incompressible laminar flow between two infinite parallel stationary plates, the shear stress variation is _____ *1 K2 CO5*
(a) Linear with zero value at the plates (b) Linear with zero value at the center
(c) Quadratic with zero value at the plates (d) Quadratic with zero value at the centre

15. Assertion (A): Loss of head at sudden expansion of a pipe is larger than that at a sudden contraction *1 K2 CO5*
Reason (R): Separation of flow occurs at sudden contractions
Which of the following is true?
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

16. The loss of head at various pipe fittings is given by the expression $k\frac{v}{2g}2$. If values of K were 0.40, 0.90, 1.5, and 2.2, then these would correspond respectively to _____ *1 K1 CO5*
(a) Foot valve of pump, 45° elbow, 90° elbow and close return bend
(b) 90° elbow, foot valve of pump close return bend and 45° elbow
(c) 45° elbow, 90° elbow, foot valve of pump and close return bend
(d) Foot valve of pump, close return bend, 45° elbow and 90° elbow

17. In a flow over plate laminar boundary layer exists, where velocity distribution is $\frac{u}{U} = 0.5\frac{y}{\delta}$. Ratio of momentum thickness to boundary layer thickness is $\frac{1}{n}$. Find the value of n. *1 K2 CO6*
(a) 4 (b) 5 (c) 6 (d) 7

18. Boundary layer thickness increases as _____ *1 K2 CO6*
(a) distance from the leading edge increases (b) velocity of the fluid increases
(c) boundary layer changes from laminar to turbulent (d) All of the above

19. The thickness of the boundary layer at a distance 'X' from the leading edge over a flat plate varies as _____ *1 K1 CO6*
(a) X (b) $\sqrt{X}$ (c) $X^{1/5}$ (d) $X^{4/5}$

20. The maximum contribution of total drag in case of air foil is due to _____ *1 K2 CO6*
(a) form drag (b) frictional drag (c) pressure drag (d) none of the above

PART - B (10 × 2 = 20 Marks)
Answer ALL Questions

21. Why fluids cannot sustain shear stress? *2 K2 CO1*

22. A plate at a distance of 1mm from a fixed plate moves at 60m/s and requires a force of 2 N/m^2 to maintain speed. Determine the fluid viscosity between the plates. *2 K2 CO1*

23. A hydraulic press has a ram of 15cm diameter and plunger of 1.5cm. It is required to lift a weight of 1000kg. Calculate the force required on the plunger. *2 K2 CO2*

24. What is the difference between hydrostatic force and buoyant force? *2 K2 CO2*

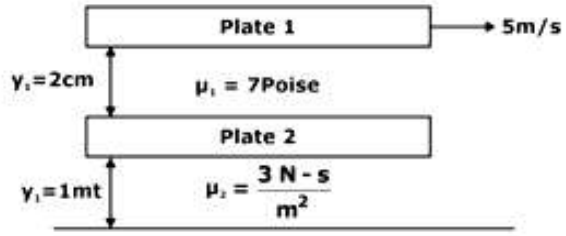
25. If the velocity field is given by u = 3x + 4y and v = 4 – 2y, then determine the circulation around a circle of radius 2 units. *2 K2 CO3*

26.	An orifice having a diameter of 10cm discharging water and the venacontracta formed has a diameter of 9cm If the coefficient of velocity is 0.96, then what is the coefficient of discharge?	2	K2	CO3
27.	What are units and dimensions?	2	K1	CO4
28.	Why are distorted models used in the construction model of a river?	2	K2	CO4
29.	Given a fluid with viscosity 0.01 poise flowing in a 6 mm diameter pipe, calculate the maximum velocity for the flow to remain laminar.	2	K2	CO5
30.	How does the shape factor influence the velocity profile within a boundary layer?	2	K2	CO6

PART - C (6 × 10 = 60 Marks)

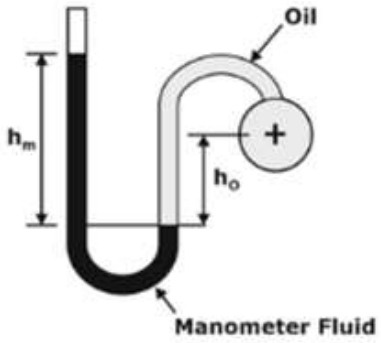
Answer ALL Questions

31.	a)	Two plates as shown in figure are arranged. If plate 1 move with a velocity of 5m/s then what will be the velocity of plate 2 (assume velocity variation between plate is linear).	10	K3	CO1



OR

	b)	Calculate the capillary effect in a glass tube of 2.5mm diameter, when immersed in water and mercury. Take σ_w = 0.0725 N/m and σ_m = 0.52 N/m in contact with air. The contact angle for water θ = 0°C and for mercury θ = 130°C.	10	K3	CO1
32.	a)	The figure shows the cross-section of an oil pipe with a manometer attached. On the right side of the manometer, the manometric fluid is in contact with oil and on the left side of the manometer is open to the atmosphere. The oil has a specific gravity of 0.85 and the manometer fluid has a specific gravity of 1.5. What is the gauge pressure at the center of the pipe, if h_m is 10cm and h_0 is 5cm?	10	K3	CO2

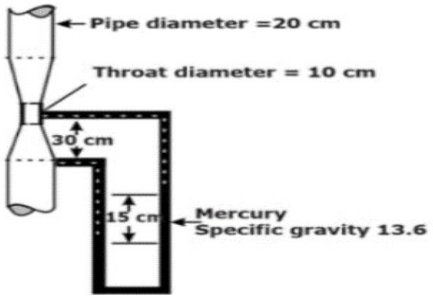


OR

	b)	A cylindrical buoy weighing 19.62 kN is floating in the ocean. The buoy has a diameter of 2 m and a height of 2.5 m. Given that the density of seawater ($\rho_{seawater}$) is 1020 kg/m^3. State whether the equilibrium is stable or unstable.	10	K3	CO2
33.	a)	The following cases represents the two velocity components, determine the third component of velocity, such that they satisfy the continuity equation $u = x^2+y^2+z^2$; $v = xy^2 - yz^2+xy$ $v = 2y^2$; $w = 2xyz$.	10	K3	CO3

OR

b) A venturimeter is connected to measure the flow of water in a vertical pipe with a diameter of 20 cm. The deflection in the mercury manometer connected to the venturimeter is 15 cm. Assuming no losses in the venturimeter and take g=9.8m/s^2, determine the flow rate of water in the pipe. *10 K3 CO3*



34. a) Using Buckingham's π theorem, show that the velocity through a circular orifice is given by $v = \sqrt{2gh}\varphi(\frac{D}{H}, \frac{\mu}{\rho v H})$ where H is the head causing flow, D is the diameter of the orifice, μ is the coefficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. *10 K3 CO4*

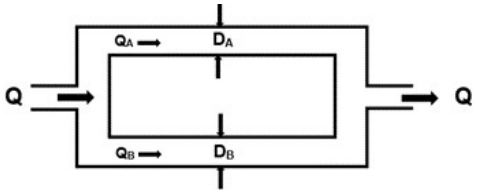
OR

b) A proposed model of a river stretch of 15km is to have a horizontal scale of 1/200 and vertical scale of 1/40. If the normal discharge, width and depth of the river are 152m^3/s, 90m and 2m respectively. Estimate the corresponding model quantities. What values of Manning's roughness n is to be provided in the model to represent a prototype roughness value of 0.025? *10 K3 CO4*

35. a) The difference in water surface level in two tanks which are connected by three pipes in series of length 300m, 170m and 210m and of diameters 300mm, 200mm and 400mm respectively is 12m. Determine the rate of flow of water, if co-efficient of friction are 0.005, 0.0052 and 0.0048m respectively. *10 K3 CO5*

OR

b) A main pipes divides into two parallel pipes which again forms one pipe as shown in figure. The length and diameter for the first parallel pipes are 2000m and 1m respectively, while the length and diameter of second parallel pipes are 2000m and 0.8m respectively. Find the rate of flow in each parallel pipe, if the total flow in the main is 3m3/s. the coefficient of friction for each parallel pipe is same and equal to 0.005. *10 K3 CO5*



36. a) Determine the shape factor for the velocity distributions in the boundary layer given by $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$, where u is the velocity at a distance y from the plate and $u = U$ at $y = \delta$, where δ =boundary layer thickness. *10 K3 CO6*

OR

b) A kite 0.8m × 0.8m weighing 0.4kgf. Assumes an angle of 12° to the horizontal. The string attached to the kite makes an angle of 45° to the horizontal. The pull on the string is 2.5kgf, when the wind is blowing at the speed of 30kmph. Find the corresponding coefficient of drag and lift. Take density of air as 1.25kg/m^3. *10 K3 CO6*