Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, December 2024

Course: Elements of Fluid mechanics **Semester: III**

Program: B. Tech Civil Engineering **Time : 03 hrs.**

Course Code: MECH2082 **Max. Marks: 100**

Instructions: Answer all questions. Draw neat sketch and assume suitable data wherever necessary.

SECTION A

(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Differentiate between piezometer and pressure gauges.	**4**	**CO1**
Q 2	State the Bernoulli's equation for a real fluid.	**4**	**CO2**
Q 3	What are major and minor losses in a pipeline?	**4**	**CO3**
Q 4	Explain Geometric, kinematic and dynamic similarities as applicable to model studies.	**4**	**CO3**
Q 5	Explain in brief the formation of boundary layer with neat sketch.	**4**	**CO4**

SECTION B

(4Qx10M= 40 Marks)

S. No.		Marks	CO
Q 6	(a) Three pipes of lengths 800m, 500m, and 400m and of diameter 500mm, 400mm, and 300 mm respectively are connected in series. These pipes are to be replaced by a single pipe of length 1750 m. Find the diameter of the single pipe. (b) Find the density of a metallic body which floats at the interface of mercury of sp.gr. 13.6 and water such that 40% of its volume is sub-merged in mercury and 60% in water.	**6+4=10**	**CO1**
Q 7	What is an orificemeter? Derive an expression for the discharge through an orificemeter.	**10**	**CO2**
Q 8	A venturimeter 30 cm x 10 cm is provided in a vertical pipeline to measure the flow of oil of relative density 0.85. The difference in elevations of the throat section and entrance section is 40 cm, the direction of flow of oil being vertically upwards. The oil-mercury differential U tube manometer shows a gauge deflection of 20 cm.	**10**	**CO3**

	Calculate the discharge of oil and the pressure difference between the entrance section and throat section. Take the coefficient of discharge as 0.97 and specific gravity of mercury as 13.6.		
Q 9	Using Buckingham's π theorem, show that the discharge Q consumed by an oil ring is given by $Q = Nd^3\emptyset[\frac{\mu}{\rho N d^2}, \frac{\sigma}{\rho N^2 d^3}, \frac{\omega}{\rho N^2 d}]$ where d is the internal diameter of the ring, N is the rotational speed, ρ is the density, μ is the viscosity, σ is the surface tension and ω is the specific weight of oil. Or (a) Explain Reynold's and Froude's model law. (b) The velocity and discharge for a $\frac{1}{50}$ scale model of a spillway are 0.35 m/sec and 0.11 m^3/sec, respectively. Calculate corresponding velocity and discharge in the prototype.	**10** Or **4+6=10**	**CO4**
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	(a) Define stream function and velocity potential. Further derive the relationship between them. (b) A fluid flow is given by $V = xy^2\boldsymbol{i} - 2yz^2\boldsymbol{j} - (zy^2 - \frac{2z^3}{3})\boldsymbol{k}$. Prove that it is a possible case of steady incompressible fluid flow. Calculate the velocity and acceleration at the point (1,2,3).	**10+10=20**	**CO3**
Q 11	(a) Derive the expression for loss of head for laminar flow between fixed parallel plates. (b) Also show that the maximum velocity is 1.5 times the average velocity. Or (a) The velocity distribution in the boundary layer is given by: $\frac{v}{V} = \frac{3}{2}\eta - \frac{1}{2}\eta^3$ where v is the velocity at a distance y from the plate, $\eta = \frac{y}{\delta}$ and v = V at $y = \delta$, δ being the boundary layer thickness. Find the displacement thickness and the momentum thickness in terms of δ. (b) What are the factors affecting the boundary layer thickness along a flat plate?	**12+8=20**	**CO4**