R.N.G.PATEL INSTITUTE OF TECHNOLOGY-RNGPIT
(An Autonomous Institute U/s UGC Act 1956)

B.Tech. SEMESTER-III, SEMESTER END EXAMINATION – WINTER 2025

SUBJECT CODE: 1ME304   **DATE: 23-12-2025**
SUBJECT NAME: FLUID MECHANICS
TIME: 11:00 AM to 01:30 PM   **TOTAL MARKS: 70**

Instructions
1. It is **compulsory** for students to write **Enrolment No. /Seat No.** on the question paper.
2. Write answers of **Section A** and **Section B** in **separate answer books**.
3. Attempt all questions from both **Section A** and **Section B**.
4. Each section carries **35 marks**, with a total of **70 marks** for the examination.
5. The figures to the right of each question indicate full marks, make suitable assumptions with justification.
6. BL - Cognitive Level (As per Revised Bloom's Taxonomy) (R-Remember, U-Understanding, A –Application, N –Analyze, E – Evaluate, C -Create), CO - Course Outcomes.

SECTION A

			Marks	BL	CO
Q.1	(a)	Define Following Fluid Properties: (1) Viscosity (2) Cavitation (3) Specific Gravity	03	R	1
	(b)	Explain and prove 'Pascal's Law'.	04	U	1
Q.2	(a)	Illustrate and discuss the different types of equilibrium that a floating body can experience.	03	R	2
	(b)	A Vertical isosceles (two sides are same) triangular plate with its vertex up has a base width 1m and height 1.5 m. If the vertex of plate is 1 m below the free water surface, find : (i) total pressure force and (ii) the Centre of Pressure.	04	A	2
	(c)	Determine the relative position of the metacenter with respect to the center of buoyancy (metacentric height).	07	U	2

OR

			Marks	BL	CO
Q.2	(a)	Describe, using a clear sketch, the various equilibrium conditions of a submerged body.	03	R	2
	(b)	A rectangular body 2 m long ,1 m wide and 0.8 m deep floats in water. The depth of immersion is 0.6 m. What is the weight of the body? Is the body in stable equilibrium?	04	A	2
	(c)	Derive the mathematical expression for the depth of the center of pressure from the liquid surface on an inclined immersed plane surface.	07	U	2
Q.3	(a)	Describe various types of fluid flows	03	R	3

(b)	A pipe **A** 400 mm in diameter, branches into two pipes (**B** and **C**) of diameters 250 mm and 150 mm respectively. If the average velocity in pipe **A** is 2 m/s, determine (i) Discharge through pipe **A**, and (ii) velocity in pipe **C** if the average velocity in pipe **B** is 1.5 m/s.	04	A	3
(c)	Derive the general continuity equation for three-dimensional flow and simplify it for steady, incompressible, two-dimensional flow in Cartesian coordinates.	07	R	3

<div align="center">OR</div>

Q.3 (a)	Define: (i) path line (ii) stream line (iii) stream tube	03	R	3
(b)	Determine whether the following flows are rotational or irrotational (1) u = -2y , v = 3x (2) u = 0 , v = 3xy (3) u = 2x , v = -2y	04	A	3
(c)	Describe the Lagrangian and Eulerian approaches used to analyze the motion of fluid particles.	07	R	3

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SECTION B

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		Marks	BL	CO
Q.4 (a)	Describe the working principle of a venture meter and derive the expression for the discharge through it.	03	U	4
(b)	State and derive Euler's equation of motion for inviscid flow along a streamline	04	R	4
Q.5 (a)	Explain the significance of Reynolds' experiment in distinguishing between laminar and turbulent flows,	03	U	5
(b)	Explain the working principle of a footstep bearing and how viscous flow affects its performance.	04	U	5
(c)	Derive the Hagen-Poiseuille formula for the flow of a viscous fluid through a circular pipe and discuss the assumptions involved.	07	A	5

<div align="center">OR</div>

Q.5 (a)	What is the Moody diagram? Explain how it is used to determine the friction factor in pipe flow.	03	U	5
(b)	Describe the collar bearing and the factors influencing the power loss due to viscous flow in it.	04	U	5
(c)	Derive the Darcy-Weisbach equation and explain the expression for the coefficient of friction in turbulent flow through pipes.	07	A	5

Q.6 (a)	Explain the difference between major and minor losses in a pipe system.	03	U	6
(b)	State Buckingham π-theorem and explain its significance in dimensional analysis.	04	R	6

(c) The resistance R to the motion of a completely submerged body depends upon the length of the body, velocity of flow, mass density and kinematic viscosity. Deduce the relationship between R and other variables by using Rayleigh's method.   **07 A 6**

<div align="center">OR</div>

Q.6 **(a)** Explain the phenomenon of water hammer and its effects on pipe systems.   **03 U 6**

(b) Using Rayleigh's method, find the dimensionless groups for the problem of flow velocity influenced by fluid density, viscosity, and pipe diameter.   **04 R 6**

(c) A compound pipe consists of three pipes of lengths 1000m, 500m, and 300 m and of diameters 50 cm, 30 cm, and 20 cm respectively are connected in series. This Pipes are replaced by a single pipe of 35 cm diameter. Calculate the length of single pipe   **07 A 6**

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