# 25CVMJ207: Fluid Mechanics

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| **w. e. f. Academic Year:** | **2026-27** |
| **Semester:** | **3rd** |
| **Category of the Course:** | **Professional Core Courses (PCC)** |
| **Prerequisite:** | Basic knowledge of Engineering Physics, Engineering Mathematics, and fundamental mechanics concepts including force, pressure, energy, and differential equations is required. Understanding of fluid properties, units and dimensions, and elementary calculus will help students analyze fluid behavior, flow systems, and hydraulic engineering applications effectively.. |
| **Rationale:** | Fluid Mechanics is a foundational course in the field of Civil Engineering and other related disciplines. It provides essential knowledge and understanding of the behavior of fluids (liquids and gases) at rest and in motion, which is critical for designing and analyzing numerous engineering systems. |

## Course Outcomes:

After completion of the course, students will be able to:

| | **Course Outcome (CO)** | **RBT Level (Cognitive Domain)** |
|---|---|---|
| CO1 | Explain the fundamental properties of fluids and analyze hydrostatic forces acting on submerged and floating bodies. | Understand |
| CO2 | Apply principles of fluid kinematics to describe fluid motion using continuity equation, flow net, stream function, and velocity potential concepts. | Apply |
| CO3 | Analyze fluid flow behavior using Bernoulli's equation, Euler's equation, and momentum principles for engineering applications. | Analyze |
| CO4 | Evaluate discharge and flow characteristics through orifices, mouthpieces, notches, weirs, and flow measuring devices such as Venturimeter and Orifice meter. | Evaluate |
| CO5 | Analyze pipe flow systems by determining head losses, hydraulic gradients, pipe network performance, and hydraulic power transmission. | Analyze |

## Teaching and Evaluation Scheme:

| Teaching Scheme | | | | | Evaluation Scheme | | | | |
|---|---|---|---|---|---|---|---|---|---|
| L | T | P | C | Hours/Week | IE | Theory | CIA | Practical | Total Marks |
| 3 | 0 | 2 | 4 | 5 | 40 | 60 | 30 | 20 | 150 |

IE: Internal Evaluation
CIA: Continuous Internal Assessment
Theory: Theory Exam (End Semester)
Practical: Practical Exam (End Semester)

## Detailed Syllabus:

| Topics | | Hours | % of Weightage |
|---|---|---|---|
| **UNIT: 1** | **Fluid Properties and Hydrostatics** | **12** | **25** |
| Properties of Fluids: Units of measurement, Mass density, Specific weight, Specific volume, Specific Gravity, Viscosity, Surface tension and Capillarity, Compressibility and Elasticity, Ideal fluids, real fluids Definition, Newtonian and non-Newtonian fluids. Pressure and its measurement, fluid pressure at a point, Pascal's law, pressure and its relation with height, atmospheric, absolute, gauge and negative pressure, measurement of pressure through piezo-meter and various types of manometer. Total pressure, intensity of pressure, centre of pressure, Pressure on horizontal , vertical, Buoyancy, centre at Buoyancy, Meta centre and Meta centre height. Condition of equilibrium of floating and submerged body. | | | |
| **UNIT: 2** | **Fluid Kinematics** | **09** | **20** |
| Types of fluid flow, methods of describing fluid motion, Langrangian and Eulerian method, Inviscid flows, velocity and acceleration, flow rate, Continuity equation, Potential flows, flow lines, velocity potential and stream function, Flownet its characteristic and utility | | | |
| **UNIT: 3** | **Fluid Dynamics** | **09** | **20** |
| Energy processed by a fluid body, Types of forces, Forces influencing fluid motion, head – Energy correction factor, Euler's and Bernoulli's equation, Application of Bernoulli's equation, Flow measurement, momentum of fluid in motion, momentum equation and momentum correction factor , Application of momentum equation. | | | |
| **UNIT: 4** | **Flow Measurement** | **07** | **15** |
| Orifice & Mouth piece Classification, hydraulic coefficients, experimental determination of hydraulic coefficient, discharge through all types of office & mouthpiece, Notches and Weirs Classification, discharge through various types of Notches and weirs, Orifice meter, Venturimeter ,Nozzles and bendmeter. | | | |

| UNIT :5 | Pipe Flow Analysis | 08 | 20 |
|---|---|---|---|
| Major and minor losses of energy in pipes, hydraulic gradient, total energy line, pipes in series, pipes in parallel, flow through branched pipes, and hydraulic transmission of power. | | | |
| | | 45 | 100 |

**LIST OF EXPERIMENTS**

| Topics | Hours |
|---|---|
| To measure the flow using different notches. | 4 |
| To determine head loss coefficients for different pipe fittings | 4 |
| To determine the Metacentric height of a given floating body. | 4 |
| To verify Bernoulli's theorem. | 4 |
| To determine Fluid friction factor for the given pipes | 4 |
| To calibrate and study different flow meter, i.e. venturi meter, orifice meter | 4 |
| To study and measure velocity of flow using Pitot tube. | 4 |
| To study laminar and turbulent flow and its visualization on the Reynolds' apparatus. | 2 |

## Suggested Specification table with Marks (Theory):

| Remember | Understand | Analyze | Apply | Create |
|---|---|---|---|---|
| 0 | 20 | 20 | 35 | 25 |

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may very slightly from above table.

## Recommended Study Materials:

Textbooks, Reference Books, and Technical Reports


1 : Bansal, R.K., Fluid Mechanics, Laxmi Publications
2 : Fluid mechanics By Dr.A.K.Jain
3 : Fluid mechanics By Dr.D.S.Kumar
4 : Fluid mechanics & Hydraulic Machines By Dr.P.N.Modi & Sheth
5 : Hydraulic Fluid mechanics & Fluid Machines By S. Ramamurthan
6 : Theory and Applications of Fluid Mechanics, K Subramanya , Tata-McGraw Hill Publishing Co, 1993, New Delhi.
7 : Fluid Mechanics , F.M., White, 5th Edition, McGraw Hill, New York.

***Web Materials***

1 : http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/fluid_mechanics/index.htm
2 : http://nptel.iitm.ac.in/video.php?subjectId=105101082
3 : http://www.mvsengineering.com
4 : http://nptel.iitm.ac.in/courses/IIT-MADRAS/Hydraulics/index.php
5 : http://nptel.iitm.ac.in/video.php?

## Teaching Learning Method

1. Lecture-based teaching-learning
2. Group-teaching and learning
3. Individual learning/self-study
4. Inquiry-based learning
5. Kinesthetic learning / Practicals
6. Expeditionary learning (Real-world problems)
7. Technology-based Learning
8. Learning through problem-solving

## Course Outcomes Mapping:

| CO. NO. | Course Outcomes (Cos) | POs/ PSOs Mapped | Cognitive Level (RBT) | Knowledge Category | Lecture (hours) |
|---|---|---|---|---|---|
| CO1 | Explain the fundamental properties of fluids and analyze hydrostatic forces acting on submerged and floating bodies. | PO1, PO2, PO6, PSO1 | Understand | Conceptual | 12 |
| CO2 | Apply principles of fluid kinematics to describe fluid motion using continuity equation, flow net, stream function, and velocity potential concepts. | PO1, PO2, PO4, PSO1 | Analyze | Conceptual & Procedural | 09 |
| CO3 | Analyze fluid flow behavior using Bernoulli's equation, Euler's equation, and momentum principles for engineering applications. | PO1, PO2, PO3, PO4, PSO1, PSO2 | Apply | Procedural & Analytical | 09 |

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|---|---|---|---|---|---|
| CO4 | Evaluate discharge and flow characteristics through orifices, mouthpieces, notches, weirs, and flow measuring devices such as Venturimeter and Orifice meter. | PO1, PO2, PO3, PO5, PO7, PSO2 | Evaluate | Procedural & Analytical | 07 |
| CO5 | Analyze pipe flow systems by determining head losses, hydraulic gradients, pipe network performance, and hydraulic power transmission. | PO1, PO2, PO3, PO5, PO7, PSO2 | Evaluate | Procedural & Analytical | 08 |

## Mapping of COs with POs & PSOs:

| COs | POs | | | | | | | | | | | | PSOs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| 1 | 3 | 3 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 |
| 2 | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 |
| 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 |
| 4 | 3 | 3 | 3 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 5 | 3 | 3 | 3 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |

**3: High, 2: Medium, 1: Low**

## Sustainable Development Goals (SDG) Integration

The course outcomes support Sustainable Development SDG 6 through efficient water management, flow measurement, and hydraulic system design. They contribute to Sustainable Development SDG 7 by promoting energy-efficient fluid transport and hydropower applications. The course also aligns with Sustainable Development SDG 9, Sustainable Development SDG 11, and Sustainable Development SDG 12 through sustainable infrastructure, pipeline efficiency, and resource conservation.

| CO | Course Outcome | Relevant SDGs | Justification |
|---|---|---|---|

| | | | |
|---|---|---|---|
| CO1 | Explain the fundamental properties of fluids and analyze hydrostatic forces acting on submerged and floating bodies. | SDG 6, SDG 9 | Promotes understanding of water behavior and hydrostatic systems essential for safe water storage, hydraulic structures, and sustainable infrastructure development. |
| CO2 | Apply principles of fluid kinematics to describe fluid motion using continuity equation, flow net, stream function, and velocity potential concepts. | SDG 6, SDG 9 | Supports efficient water distribution, irrigation systems, and sustainable urban water management practices. |
| CO3 | Analyze fluid flow behavior using Bernoulli's equation, Euler's equation, and momentum principles for engineering applications. | SDG7, SDG 12 | Encourages energy-efficient fluid transport systems and applications in hydropower and industrial fluid systems. |
| CO4 | Evaluate discharge and flow characteristics through orifices, mouthpieces, notches, weirs, and flow measuring devices such as Venturimeter and Orifice meter. | SDG 6, SDG 12 | Promotes accurate monitoring and conservation of water resources through efficient flow measurement techniques. |
| CO5 | Analyze pipe flow systems by determining head losses, hydraulic gradients, pipe network performance, and hydraulic power transmission. | SDG 9, SDG 11 | Supports sustainable design and operation of water supply and pipeline systems with reduced energy losses and improved infrastructure efficiency. |