Purbanchal University

Faculty of Engineering, Biratnagar, Nepal

Syllabus

Level: Bachelor
Program: Bachelor in Civil Engineering
Subject: FLUID MECHANICS
Subject Code: BCI----

Year: II **Semester: III**

Teaching Schedule Hours/Week					Examination Schedule						Total Marks
					Final				Internal Assessment		
					Theory		Practical		Theory Marks	Practical Marks	
Credit Hours	L	T	P	Total	Duration	Marks	Duration	Marks	40	25	125
3	3	3	2/2	7	3 Hrs.	60	-	-			

Note: **L:** Lecture **T:** Tutorial **P:** Practical

Course Objective:

The purpose of the course is to provide basic knowledge of fluid mechanics i. e., the basics of fluid statics, kinematics, dynamics and their applications in engineering particularly in civil engineering.

Course Content:

1. **Introduction (1 hour)**
   - 1.1 Concept of Fluid and comparison with solids
   - 1.2 Classification of Fluids
   - 1.3 Application of Fluid Mechanics in Civil Engineering
   - 1.4 Concept of Continuum and control volume

2. **Physical Properties of Fluid (3 hours)**
   - 2.1 Density, Specific Weight, Specific Volume, Specific Gravity, Compressibility, Surface Tension, Capillarity, Vapor Pressure and Cavitation, Viscosity and Newton's Law of Viscosity

3. **Fluid Statics (17 hours)**
   - 3.1 Intensity of Pressure and Pressure force
   - 3.2 Pressure-Depth Relationship
   - 3.3 Pascal's Law
   - 3.4 Absolute, Gauge, Atmospheric and Vacuum Pressure

3.5 Measurement of Pressure: Manometers (Piezometer, u-tube manometer, differential manometer, sensitive manometers)
3.6 Pressure on Plane Submerged Surface, Pressure Diagram and Center of Pressure
3.7 Pressure on Curved Surface
3.8 Forces on Gates (Plane and Curve), Dams and Other Water Retaining Structures
3.9 Buoyancy and Floatation
3.10 Meta Center, Meta-Centric height
3.11 Condition of Equilibrium Stability of submerged and floating bodies
3.12 Fluid within a Rigid Body Subjected to Motion (Acceleration and Rotation)

4. Fluid Kinematics (5 hours)

4.1 Lagrangian and Eulerian Approaches of Describing Fluid Flow
4.2 Types of flow as Steady and Unsteady, Uniform and Non-Uniform, Laminar and Turbulent
4.3 One, Two and Three dimensional Flow
4.4 Stream Lines, Streak Lines, Path Lines, Stream Tube
4.5 Principle of Conservation of Mass
4.6 Derivation of Equation of Continuity in Cartesian Co-ordinates; Continuity equation for two-dimensional and one-dimensional flow
4.7 Introduction of Continuity Equation in Polar Co-ordinates
4.8 Velocity and acceleration of fluid particles; Local and Convective acceleration

5. Fluid Dynamics (17 hours)

5.1 Various Forces Acting on Fluid
5.2 Euler's Equation of Motion
5.3 Derivation of Bernoulli's Equation from Euler's Equation; various forms of energies in fluid flows
5.4 Bernoulli's equation for real fluid
5.5 Application of Bernoulli's Equation to Orifice and Mouthpiece
5.6 Determination of hydraulic coefficients
5.7 Venturimeter, Orifice-meter, Nozzlemeter and Pitot Tube
5.8 Derivation of Momentum Equation
5.9 Application of Momentum Equation to calculate Forces on Pipe Bends, Reducers, etc.
5.10 Force Exerted by Jets on Moving and Stationary Vanes of different shapes
5.11 Concept of Angular Momentum; Problems of Sprinklers
5.12 Varying Head Flow: Emptying and Filling of Tanks; Examples of rectangular, cylindrical (vertical) and hemispherical tanks

6. Boundary Layer Theory (2 hours)

6.1 Concept of Boundary Layer

6.2 Boundary Layer concept along a thin layer (Laminar Zone, Turbulent Zone, Transition Zone as well as Laminar Sub-layer)

6.3 Boundary Layer Thickness, Displacement Thickness, Momentum Thickness, Energy Thickness

6.4 Smooth and Rough Boundary examples

Laboratory Works:

1. Newton's Law of Viscosity (Optional)
2. Force on Submerged Surface
3. Study of Flow Patterns
4. Verification of Bernoulli's Principle
5. Flow through orifice and mouthpiece
6. Calibration of Flowmeters: venturimeter
7. Impact of Jet
8. Cavitation demonstration (Optional)
9. Manometers and pressure measuring device demonstration (Optional)
10. Determination of Metacentric Height (Optional)
11. Pascal's Law Demonstration (Optional)

References*:

1. Bansal, R. K. (2019). *A Textbook of Fluid Mechanics and Hydraulic Machines*. 10th edition, Laxmi Publications
2. Cengel, Y. A. & Cimbala, J. M. (2013). *Fluid Mechanics: Fundamentals and Applications.* 3rd edition, Mcgraw-Hill
3. Dulal, K.N. (2022). *Fluid Mechanics*. 1st Edition, Pratibha Pustak Sadan.
4. Kumar, D. S. (2013). *Fluid Mechanics and Fluid Power Engineering*. 8th edition, S. K. Kataria and Sons
5. Modi, P. N. & Seth, S. M. (2015). *Hydraulics and Fluid Mechanics including Hydraulic Machines*. 20th edition, Standard Book House
6. Sangroula, D. P. (2018). *Fundamentals of Fluid Mechanics*. 3rd edition, Green Books
7. Streeter, V. L., Wylie, E. B. & Bedford, K. W. (2010). *Fluid Mechanics*. 9th edition, Mcgraw-Hill

**Latest edition will be preferable.*