SHIV NADAR UNIVERSITY

I. **Course Title:** Fluid Mechanics

II. **Course Code:** CED 202

III. **Course Credits (L:T:P):** (3:1:0)

IV. **Course Type:** Major/UWE

V. **Prerequisite/s (If Any):** High School Physics and Mathematics

VI. **Course Coordinators/Instructor(s):** Dr. Gopal Das Singhal

VII. **School:** School of Engineering

VIII. **Department:** Civil Engineering

IX. **Objective:** The concept of fluid mechanics in civil engineering is essential to understand the processes and science of fluids. The course deals with the basic concepts and principles in hydrostatics, hydro kinematics and hydrodynamics with their applications in fluid flow problems.

The objective of this Course is provide; Properties of fluids and basic concepts applicable to fluid mechanics and its relevance in civil engineering, Fundamentals of hydrostatics viz. Pascal's law, hydrostatic law and determination of hydrostatic pressure and centre of pressure of surfaces; Principle of buoyancy and its application; The concept of fluid kinematics and ideal fluid flow; Concepts of control volume, control surface and dynamics of fluid flow; Various flow measuring devices and their applications; To understand the Pipe flow problems, losses incurred during transmission of power through pipe

X. **Learning Outcomes:** Upon successful completion of the course, student should be able to

- Define various properties of fluids, state and explain different types of laws and principles of fluid mechanics.
- Interpret different forms of pressure measurement and Calculate Hydrostatic Force and its Location for a given geometry and orientation of plane surface.
- Compute force of buoyancy on a partially or fully submerged body and analyse the stability of a floating body.
- Distinguish velocity potential function and stream function and solve for velocity and acceleration of a fluid at a given location in a fluid flow.
- Derive Euler's Equation of motion and Deduce Bernoulli's equation.
- Measure velocity and rate of flow using various devices.
- Interpret different pipe fittings and evaluate the fluid velocity considering major and minor losses.

XI. **Course Content:**

Module 1: Fundamental Concepts of properties such as Mass density, weight density, specific gravity, specific volume, viscosity, compressibility and elasticity, surface tension, capillarity, vapor pressure, types of fluids, basic concepts applicable to fluid mechanics.

Module 2: Fluid statics: Pascal's law, hydrostatic law, pressure variation in fluids at rest. Absolute, atmospheric, gauge pressure, measurement of pressure using manometers.
Total pressure and centre of pressure, total pressure on horizontal plane surface, vertical plane surface, Inclined plane surface, centre of pressure for vertical plane surface and for inclined plane surface, practical applications of total pressure and centre of pressure on dams, gates, and tanks.
Module 3: Fluid kinematics: Types of fluid flow, description of flow pattern, Lagrangian methods, Eulerian method, continuity equation, velocity and acceleration of fluid particles, velocity potential and stream function, streamline, streak line, path line, equipotential lines and flow net, uses of flow net, rotational and irrotational motions, circulation and vorticity
Module 4: Fluid dynamics: Control volume and control surface, Forces acting on fluid in motion, NavierStokes Equation, Euler's Equation of motion, Integration of Euler's equations of motion, Bernoulli's Theorem and its derivation, Bernoulli's equation for compressible fluid and real fluid,
Module 5: Flow Measurement Devices: Practical applications of Bernoulli's Equation - Venturimeter, Orifice meter, nozzle meter, pitot tube.

Module 6: Flow through pipes: Loss of head through pipes, Darcy-Weisbach equation, minor and major losses. Hydraulic gradient line and energy gradient line, pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flow through branched pipes, three reservoir problem, siphon.
Module 7: Dimensional analysis and similitude: Dimensional homogeneity, Buckingham's π theorem, important dimensional numbers and their significance, geometric, Kinematic and dynamic similarity, model studies.
Module 8: Boundary Layer Analysis: Development of boundary layer over flat surfaces. Boundary layer thickness

XII. **Recommended Books:**

Text Books:

1. Fluid Mechanics: Including Hydraulic Machines, by A. K. Jain; Khanna Publishers; 2008.
2. Hydraulics and Fluid Mechanics Including Hydraulics Machines, by P. N. Modi; Standard Book House; 2009. , ISBN: 8189401262, ISBN-13: 9788189401269.
3. Fluid Mechanics by R. K. Rajput; S. Chand; 2011, ISBN: 81-219-1666-6

Reference Books:

1. Fluid Mechanics, by Frank White; Tata McGraw Hill Education Pvt. Ltd.; 2011.
2. Fluid Mechanics and Machinery by C.S.P.Ojha et.al, Oxford University Press, 2010, ISBN: 0-19-569963-7.
3. Fluid Mechanics by R. C. Hibbeler, Pearson Press, 2017, ISBN: 978-93-325-4701-8.

4. Fluid Mechanics by Streeter, V.L. and Benjamin, W.E., McGraw-Hill.

XII. **Assessment Scheme:**

Mid Term	:	20%
Quizzes &/ Assignment	:	20%
Lab Work	:	20%
Major Exam	:	40%