Course Objective:

- The course will introduce the principle of fluid mechanics and establish its relevance in civil engineering.
- Develop the fundamental principles underlying the subject.
- The laboratory component of the course will allow “hands-on” learning through experiments relating to open channel and pipe flow.
- Students completing this course should have the tools necessary for analysis of field problems in fluid mechanics.

Course Content:

PART (I): ELEMENT OF FLUID MECHANICS

Chapter 1: Fluid and Their Properties. (Week: 1, 2)

1.1 Fluid.
1.2 Shear stress in a moving fluid.
1.3 Difference between solids and fluids.
1.4 Newtonian and non-Newtonian fluids.
1.5 Liquids and gases.
1.6 Density.
1.7 Viscosity.
1.10 Causes of viscosity in gases.
1.11 Causes of viscosity in a liquid.
1.12 Surface tension.
1.13 Capillarity.
1.16 Compressibility and the bulk modulus.

Chapter 2: Pressure and Head. (Week: 3 & 4)

2.1 Static of fluid system.
2.2 Pressure.
2.3 Pascal’s law of pressure at a point.
2.4 Variation of pressure vertically in a fluid under gravity.
2.5 Equation of pressure at same level in static fluid.
2.6 General equation for the variation of pressure due to gravity from point to point in a static fluid.
2.7 Variation of pressure with altitude in a fluid of constant density.
2.13 Pressure and Head.
2.14 The hydrostatic paradox.
2.15 Pressure measurements by manometer.

Chapter 3: Static Forces on Surfaces – Buoyancy. (Week: 5 & 6)

3.1 Action of fluid pressure on a surface.
3.2 Resultant force and center of pressure on a plane surface under uniform pressure.
3.3 Resultant force and center of pressure on a plane surface immersed in a liquid.
3.4 Pressure diagram.

PART (II): CONCEPT OF FLUID FLOW

Chapter 4: Motion of Fluid Particles and Streams. (Week: 7 & 8)

4.1 Fluid flow.
4.2 Uniform flow and steady flow.
4.4 Real and ideal fluids.
4.5 Compressible and incompressible flow.
4.6 One, two, and three dimensional flow.
4.10 Laminar and turbulent flow.
4.11 Discharge and mean velocity.
4.12 Continuity of flow.

Chapter 5: The momentum Equation and its Applications (Week: 9, 10 & 11)

5.1 Momentum and fluid flow.
5.2 Momentum equation for two and three dimensional flow along a streamline.
5.5 Force exerted by a jet striking a flat plate.
5.6 Force due to the deflection of a jet by curved vane.
5.7 Force exerted when a jet deflected by a moving curved vane.
5.8 Force on pipe bends and closed conduits.
5.9 Reaction of jet.
5.12 Euler’s equation of motion along streamline.

Chapter 6: The energy Equation and its Application. (Week: 12, 13 & 14)

6.1 Mechanical energy of flowing fluid.
6.2 Steady flow energy equation.
6.4 Application of the steady flow energy equation.
6.5 Representation of energy change in a fluid system.
6.6 The Pitot tube.
6.7 Determination of volumetric flow rate via Pitot tube.
6.9 Changes of pressure in a tapering pipe.
6.10 Principle of the venturi meter.
6.11 Pipe orifices.
3.5 Force on a curved surface due to hydrostatic pressure.
3.6 Buoyancy.
3.7 Equilibrium of floating bodies.
3.8 Stability of submerged bodies.
3.9 Stability of floating bodies.
3.10 Determination of metacentric height.
3.11 Determination of the position of metacentric relative to the center of buoyancy.

6.12 Limitation on the velocity of flow in a pipeline.
6.13 Theory of small orifices discharging to atmosphere.
6.14 Theory of large orifices.
6.15 Elementary theory of notch and weirs.
6.16 The power of a stream of fluid.

Midterm Exam (22/11/2009)

Textbook:

Other key references: Any book with the title of Fluid Mechanics such as:

Prerequisite: Engineering Mechanics Dynamics.

Homework problems:
To be assigned at the end of each chapter as problem sheet

Exams and Grading Policy:
Homework and Quizzes .................................................................................. 10 %
Laboratory experiments .................................................................................. 10%
Mid-term Exam ................................................................................................. 30 %
Final Exam ....................................................................................................... 50%
Total ................................................................................................................. 100%

Instructions:
• Attendance Policy: Attendance is important. Students with absence that exceeds 25% will not be permitted to take the final exam.

• Homework Policy: Homeworks are due one week after the day they were assigned. Late homeworks cannot be accepted and will not be graded.

• Exam Policy: Exams are closed book.