# Course Syllabus

| Course Code | Course Title | ECTS Credits |
|---|---|---|
| MENG-280 | Fluid Mechanics | 6 |
| **Prerequisites** | **Department** | **Semester** |
| MATH-191 | Engineering | Spring Summer |
| **Type of Course** | **Field** | **Language of Instruction** |
| Required | Mechanical Engineering | English |
| **Level of Course** | **Lecturer(s)** | **Year of Study** |
| 1st Cycle | T.B.A | 2nd |
| **Mode of Delivery** | **Work Placement** | **Corequisites** |
| Face-to-face | N/A | None |

**Course Objectives:**

The main objectives of the course are to:

- Introduce student to the subject of fluid mechanics;
- Present the system and control volume approaches for analysing fluid behaviour;
- Explain the continuum hypothesis, viscosity, Newtonian & Non-Newtonian fluids;
- Outline the fundamentals of fluid statics, hydrostatics and floating bodies;
- Appreciate the utility of differential analysis;
- Familiarize attendees with the fundamental fluid flow equations;
- Cover fluid kinematics and dynamics;
- Express the Bernoulli equation and dimensional analysis;
- Introduce the Navier-Stokes equations;
- Introduce and explain the basic characteristics of turbulent flow and energy losses;
- Analyze lift generation and aerodynamics;
- Elaborate on the importance of compressible and isentropic fluid flow;
- Relate fluid mechanics to real-world and research applications, including a general introduction to experimental fluid mechanics and computational fluid dynamics.

**Learning Outcomes:**

After completion of the course students are expected to be able to:

- Recognise the characteristics of fluids and their behaviour;
- Utilize the system and control volume fluid methods of analysing flows;
- Distinguish between different systems of dimensions;
- Appreciate the notion of viscosity, Newtonian & non-Newtonian fluids;
- Tackle basic engineering problems associated with hydrostatic forces, buoyancy, and stability of floating & submerged bodies;
- Apply the conservation of mass & continuity equations;
- Understand fluid motion;
- Characterise rotational and irrotational flows;
- Understand fluid circulation and lift-generation;
- Discern the subtleties of stream functions and the velocity potential;
- Apply the Bernoulli and energy equations to understand fluid behaviour;
- Use dimensional analysis and non-dimensionalisation;
- Appreciate the importance of Navier-Stokes equation;
- Comprehend the basic features of turbulent flow and energy losses;
- Calculate lift generation and basic aerodynamic parameters;
- Provide hands on laboratory experience through a basic laboratory experiment (e.g. hydrostatic pressure, flow in Venturi tubes, pressure & energy losses).

**Course Content:**

- Distinction between fluids (liquid & gases) and solids;
- System and control volume fluid methods of analyses, Lagrangian & Eulerian descriptions;
- Dimensions, units, and systems of dimensions;
- Continuum hypothesis, velocity fields, steady & unsteady flows;
- Viscosity, Newtonian & non-Newtonian fluids;
- Pressure, hydrostatic forces, buoyancy, floating & submerged bodies;
- Integral and differential analyses;
- Conservation of mass & continuity equation;
- Motion and deformation of fluid elements;
- Fluid vorticity, rotational and irrotational flows;
- Circulation and lift-generation;
- Stream function and the velocity potential;
- Bernoulli and energy equations;
- Dimensional analysis and non-dimensionalisation;
- Euler and Navier-Stokes equations;
- Introduction to turbulent flows;
- Introduction to aerodynamic forces;
- Introduction to experimental methods.

**Learning Activities and Teaching Methods:**

Lectures, tutorials, in-class examples, discussion

**Assessment Methods:**

| |
|---|
| Mid-term and final exams, project assignment |

**Required Textbooks / Readings:**

| Title | Author(s) | Publisher | Year | ISBN |
|---|---|---|---|---|
| Y. A. Çengel and J. M. Cimbala | Fluid Mechanics: Fundamentals and Applications. | McGraw Hill, New York | 2017 | 1259696537, 9781259696534 |

**Recommended Textbooks / Readings:**

| Title | Author(s) | Publisher | Year | ISBN |
|---|---|---|---|---|
| White M. Frank | Fluid Mechanics, 7th ed. | McGraw-Hill | 2009 | 978-0-07-352934-9 |
| Katz Joseph | Introductory Fluid Mechanics | Cambridge University Press | 2010 | 978-0-521-19245-3 |

**Weekly Schedule**

| Week | | Topic |
|---|---|---|
| 1 | Day 1 | Types of fluids (liquid & gases). The Lagrangian & Eulerian descriptions for system and control volume fluid methods. |
| | Day 2 | Dimensions, units, and systems of dimensions for fluid mechanics. The Continuum hypothesis and velocity fields (steady & unsteady flows). |
| 2 | Day 1 | Newtonian & non-Newtonian fluids the influence of Viscosity. Pressure, hydrostatic forces, buoyancy, floating & submerged bodies. |
| | Day 2 | The Integral and differential types of analyses. |
| 3 | Day 1 | Conservation of mass & continuity equation. Motion and deformation of fluid elements. |
| | Day 2 | Fluid vorticity, rotational and irrotational flows. |
| 4 | Day 1 | Midterm |

| | | |
|---|---|---|
| 4 | Day 2 | Circulation and lift-generation. Stream function and the velocity potential. |
| 5 | Day 1 | Bernoulli and energy equations. |
| | Day 2 | Introduction to dimensional analysis and non-dimensionalisation. |
| 6 | Day 1 | Description of the Euler and Navier-Stokes equations and introduction to turbulent flows. |
| | Day 2 | Final examination. |