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| **Course Code**<br>MENG-280 | **Course Title**<br>Fluid Mechanics | **ECTS Credits**<br>6 |
| **Department**<br>Engineering | **Semester**<br>Fall, Spring | **Prerequisites**<br>PHYS-150, MATH-330 |
| **Type of Course**<br>Required | **Field**<br>Engineering | **Language of Instruction**<br>English |
| **Level of Course**<br>1st Cycle | **Year of Study**<br>2nd | **Lecturer(s)**<br>Dr Constantinos Hadjistassou |
| **Mode of Delivery**<br>Face-to-face | **Work Placement**<br>N/A | **Co-requisites**<br>None |

**Objectives of the Course:**

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 equation;
- Explain the 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.

**Learning Outcomes:**

After completion of the course students are expected 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 engineering problems associated with hydrostatic forces, buoyancy, and stability of floating & submerged bodies;
- Apply the conservation of mass & continuity equations;
- Understand fluid motion and deformation of fluids;
- Characterise rotational and irrotational flows;
- Know what is 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 features of turbulent flow and energy losses;
- Calculate lift generation and aerodynamic parameters;

**Course Contents:**

- 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 equations, incompressible Navier-Stokes equation, approximate solutions;
- Turbulent flows, fluid energy losses, generation of eddies, Reynold's number, fluid instabilities;
- Drag, friction and pressure drag, drag reduction, lift (force) theory, aerodynamic forces, Prandtl theorem, vortex theory;

**Learning Activities and Teaching Methods:**

Lectures, in-class examples, discussion

**Assessment Methods:**

Homework, project assignments, tests, final exam

**Required Textbooks/Reading:**

| Authors | Title | Publisher | Year | ISBN |
|---|---|---|---|---|
| Robert W. Fox, Alan T. McDonald, Philip J. Pritchard | Fluid Mechanics | Wiley | 2011 | 978-1-118-02641-0 |

**Recommended Textbooks/Reading:**

| **Authors** | **Title** | **Publisher** | **Year** | **ISBN** |
|---|---|---|---|---|
| Clayton T. Crowe | Engineering Fluid Mechanics | Wiley | 2009 | 9780470409435 |