UNIVERSITY of NICOSIA

Course Syllabus

Course Code	Course Title	ECTS Credits
MENG-462	Fluid Dynamics	6
Prerequisites	**Department**	**Semester**
MENG-280	Engineering	Fall, Spring
Type of Course	**Field**	**Language of Instruction**
Elective	Engineering	English
Level of Course	**Lecturer(s)**	**Year of Study**
1st Cycle	Prof Dimitris Drikakis	3rd or 4th
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:

- Better understand the mechanics of fluid flows in conduits
- Be able to analyse and model non-Newtonian flows in a variety of contexts

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- Appreciate the challenges associated with the fluid mechanics of turbulence as applied to engineering problems
- Comprehend the mathematics of partial differential equations in fluid dynamics
- Recognize the physics behind the phenomenon of cavitation and the transport processes of convection, diffusion and advection
- Solve practical problems associated with drag forces and lift generation
- Be familiar with the approximations and results of the Navier-Stokes equation
- Know the characteristics of compressible flow, shock waves and their uses
- Understand the concepts associated with fluid flow in porous media
- Familiarise themselves with two-phase and three-phase flows
- Be aware of the numerical techniques used to solve PDEs and the tools used to solve and visualize such problems

Course Content:

Course syllabus comprises:

- Fully developed flow, turbulent flows in pipelines, minor and major energy losses, fluid compression and pumping, flow rate measurements
- Characteristics of non-Newtonian fluids, Bingham plastics, pseudoplastics and dilatants and their modelling
- Turbulent flows, fluid energy losses, generation of eddies, Reynold's number, fluid (in)stabilities
- Physics of cavitation, cavitation inception, types of cavitation, cavitation issues on propeller blades, pumps and control valves
- Convection in gases and liquids, the convection-diffusion equation, advection equation
- Drag, friction and pressure drag, drag reduction, lift (force) theory, aerodynamic forces, Euler equations, Prandtl theorem, vortex theory
- Creeping flow, Cauchy momentum equation, incompressible Navier-Stokes equation, approximate solutions
- Mach number, steady flow 1D compressible fluid flow, 1D isentropic fluid flow
- Porosity, seepage velocity, continuity equation, Darcy's Law, inertial effects
- Flow assurance, mass conservation, energy conservation, slug flow, 2D & 3D fluid flow
- Governing equations of fluid flow, classification and the solution of partial differential equations, Computational Fluid Dynamics and flow visualisation
- Problem formulation, discretization methods, boundary conditions and initial conditions
- The finite difference method, the finite element method and the finite volume method.

Learning Activities and Teaching Methods:

Lectures, in-class exercises, examples

Assessment Methods:

Problem sheets, mid-term, simulation exercises, final exam.

Required Textbooks / Readings:

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

Recommended Textbooks / Readings:

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