COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Engineering		
ACADEMIC UNIT	Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	EN0201	**SEMESTER**	4th
COURSE TITLE	Fluid Mechanics I		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	5	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialized general knowledge, skills development*	Background
PREREQUISITE COURSES:	There are no prerequisite courses. It is recommended that students who are interested in attending the course have completed successfully the following courses: Applied Mathematics I & II, Ordinary Differential Equations, Thermodynamics.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://mie.uth.gr/?page_id=17844&lang=en

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The goal of this course is to introduce the student to the fundamental principles of the static and dynamic analysis of fluids and to familiarize him/her with basic calculations towards the prediction of static force distribution and essential dynamic properties of fluid flow in the framework of the integral form of the basic conservation laws. Upon successful completion of the course the student will be able to:

- Master the basic principles that distinguish a fluid from a solid along with the most important fluid properties – Identify the different flow types in terms of geometry and flow arrangement along with the relevant dimensionless parameters that characterize them
- Master the basic tools for analyzing the kinematic state of a fluid – Lagrangian vs Eulerian formulation and the corresponding ways to represent the flow field, streamlines streaklines and pathlines
- Analyze the motion of a fluid element via the concepts of divergence and rotation of the velocity field and the introduction of the rate of deformation tensor – Dynamic analysis of fluid motion – The concept of a Newtonian fluid and the linear relation between stress and rate of deformation tensors
- Perform static analysis of fluids and predict the distribution of forces in a fluid at rest – Application to the study of forces exerted on submerged objects at equilibrium and the resulting stability requirements
- Apply Bernoulli's principle in simple flow situations along and perpendicularly to the streamlines, and obtain first principle estimates of flow properties of ideal flows
- Perform first principle conservation laws, mass momentum and energy, using the concept of control volume and applying simple integral balances in order to obtain first order estimates of flow properties and force distribution in fluids.
- Employ the above ideas in a laboratory experiment with a pipe system

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for analysis and synthesis of data and information by combining theoretical concepts with physical models and laboratory measurements.
- Working independently and in the context of a team
- Production of critical, creative and inductive thinking to obtain a preliminary description of specific problems via simple integral balances

(3) SYLLABUS

- Applications of fluid mechanics – Fluids vs Solids and the theory of continuum – Basis properties of fluids
- Properties of the flow field – Analysis and representation of the flow field – Kinematics of fluids – Lagrangian and Eulerian representation of fluids – Velocity and acceleration fields
- Graphic representation of the flow field, pathlines, streamlines and streaklines – The concept of stream function – Deformation of a fluid element – Divergence and rotation of the velocity field and deformation tensor
- Nature of forces in a fluid –Volume, line and surface forces –Tensor calculus and the constitutive laws - Stress tensor and the concept of Newtonian fluid with a linear stress/rate of deformation tensor relation
- Integral and differential form of the forces in a static fluid – Pressure as isotropic stress state at rest – Distribution of forces in a fluid at rest and Pascal's principle – Hydrostatic forces on plane and curved submerged surfaces – Buoyancy and stability of floating objects
- Flow of ideal fluids and integration along and perpendicularly to the stream lines – Derivation of the Bernoulli's principle form the differential form of the equations of motion for an ideal fluid – Bernoulli's equation as a form of energy conservation for ideal fluids and applications of it
- Macroscopic analysis of flowing fluids via the Reynolds transport theorem using the concept of control volume – Conservation of mass in integral and differential form – Simplified forms of the integral mass balance for steady state
- Integral form of newton's second law for a control volume in moving and accelerated systems – First order estimates of forces exerted in moving fluids
- Integral form of the first law of thermodynamics and combination with the integral form of the conservation of mechanical energy - The concept of Hydraulic and energy grade lines for frictionless fluid and its modification in the presence of friction and irreversible energy loss
- Friction losses in laminar and turbulent flow and Moody's diagram, with application of the macroscopic energy and mass balances for the study of flow in pipe systems – Laboratory case study in order to calibrate the performance of an axial flow pump

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY ***Face-to-face, Distance learning, etc.***	Face to face (class) and laboratory
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Support of the learning process with material that is uploaded on the internet site of the course, homework problem and a laboratory case study

TEACHING METHODS	*Activity*	*Semester workload*
The manner and methods of teaching are described in detail. *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive*	Lectures	70
	Homework	30
	Study at home	50

teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non- directed study according to the principles of the ECTS*		
	Course total (25 hours of work load per unit of credit)	*150*

STUDENT PERFORMANCE EVALUATION ***Description of the evaluation procedure*** *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open- ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final exam (70%) Midterm Exam (30%) The evaluation criteria may vary among different academic years but on average they follow the above distribution. In any case they the students are notified regarding the evaluation procedure in the beginning of each semester and the specific criteria are uploaded on the course's web page in the Department's internet site.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- B. R. Munson, D. F. Young and T. H. Okiishi, «Μηχανική των Ρευστών», 8Th Edition, Εκδόσεις Τζιόλα (Μετάφραση, Κ. Υάκινθος), 2017
- White, F.M., 'Fluid Mechanics',, 9th Ed., McGraw-Hill, 2021, (Translation in Greek, N Pelekasis 2025, Εκδόσεις Κλειδάριθμος)
- Papaioannou, A., 'Fluids Mechanics',Vols. I & II, 1993 & 1996 (in Greek)
- V.L. Streeter & E.B. Wylie, 'Fluid Mechanics', Translation: G. Tsimikalis, Fountas Publ., 2000 (in Greek)
- Bergeles, G., D. Papantonis & S. Tsagaris, 'Technical measurements of Fluid Meachanics Quantities', Symeon Publ., 1998 (in Greek)

- Related academic journals:

- Journal of Fluid Mechanics
- Journal of the Acoustical Society of America
- Physics of fluids
- Journal of Computational Physics
- International Journal of Heat and Mass Transfer