COURSE OUTLINE

1. GENERAL

SCHOOL	NATURAL SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF COURSE	UNDERGRADUATE		
COURSE CODE	MAT_AM466	**SEMESTER OF STUDIES**	8th
COURSE TITLE	FLUID MECHANICS		

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*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures and Tutorials	4	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, specialised general knowledge, skills development*	Elective course
PREREQUISITE COURSES:	Recommended prerequisite knowledge: INTRODUCTION TO ORDINARY DIFFERENTIAL EQUATIONS, CALCULUS IV, CLASSICAL MECHANICS
TEACHING AND ASSESSMENT LANGUAGE:	Greek
THE COURSE IS OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBPAGE (URL)	http://www.math.upatras.gr/~weele/weeleteaching_WinterSemester.htm

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*

In this course the student acquires a sound working basis for describing, in mathematical language, the statics and dynamics of fluids and continuous media in general. The student learns how the principles of Classical Mechanics can be used to describe not only the motion of discrete solid bodies but also, in the form of a field theory, the motion of continuous media such as fluids and gases. Basic concepts in this type of description are e.g. the density field of the fluid (instead of the mass of the individual bodies in Classical Mechanics) and the velocity field (instead of the velocities of each body apart). A central role here is played by Vector Calculus, which is taught in the mandatory course "Calculus IV". Thus, the student becomes acquainted with the way in which the concepts of this branch of Mathematics (such as the divergence and curl of a vector field, line and surface integrals, and the theorems of Stokes and Gauss) are applied to describe the motion of fluids.

After sucessfully completing the course, the student will have a good basic knowledge of Fluid Mechanics, i.e., of laminar flows both for ideal (non-viscous) and for real fluids. The student will have learnt how to apply the mathematical concepts of Vector Calculus in the context of one of the most important and fascinating fields of classical physics, and will be able to model a multitude of phenomena encountered in daily life, in the physical environment and in countless industrial applications.

General Abilities

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
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
Others…

- Finding, analyzing and combining facts and information using the most suitable technologies.
- Adapting to new situations.
- Working and studying autonomously.
- Working in a team.
- Generating new research ideas.
- Stimulating free, creative and constructive thinking.

3. COURSE CONTENT

Basic concepts and properties of fluids (density, pressure, stress, compressibility, viscosity, etc.). Statics of fluids and practical applications thereof (balance of forces in a fluid at rest, pressure gradient, the buoyant force and the Principle of Archimedes, Pascal's Principle). Kinematics of fluids (description of the motion according to the methods of Lagrange and Euler, respectively, total derivative, velocity field, acceleration field, pressure field, path lines and streamlines, circulation, volumetric flux, irrotational flow described by means of the velocity potential). Detailed analysis of the motion of fluids (translation, rotation, linear and angular deformation) in various coordinate systems. Boundary conditions, the no-slip condition for real fluids. The continuity equation and the concept of the stream function. Complex potential and applications. Equations of motion for ideal fluids and integrals thereof (the equations of Euler, Bernoulli's Principle, Torricelli's law, Lagrange's theorem) and applications. Equations of motion for real fluids (the Navier-Stokes equations) and applications: Couette flow, Hagen-Poisseuille flow, and others.

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc*	Lectures (face to face)
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in teaching, laboratory education, communication with students*	✓ Use of information and communication technologies in the classroom, the tutorial classes, and for communication with the students. ✓ Website of the course. ✓ Use of the Department's online platform MyMath.

TEACHING ORGANIZATION
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 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

Activity	***Semester workload***
Lectures	52
Solving suggested exercises	28
Self-study during the semester	40
Preparation for the final examination	27
Duration of the written final examination	3
Total number of hours for the Course (25 hours of work-load per ECTS credit)	**150**

STUDENT ASSESSMENT *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*	**Assessment Language:** Greek **Assessment Language for Erasmus students:** English **Assessment methods:** Written final examination (100%) including: ✓ Theory, ✓ Exercises, ✓ Real-world applications of Fluid Mechanics. Minimum passing grade: 5 Maximum passing grade: 10

5. RECOMMENDED LITERATURE

(*in Greek*)

- Elger Donald F., Williams Barbara C., Clayton Crowe T. and Roberson John A. *Μηχανική Ρευστών*. $10^{η}$ Έκδοση, Εκδόσεις Τζιόλα, 2015.
- Λιακόπουλος Αντώνιος. *Μηχανική Ρευστών*. Εκδόσεις Τζιόλα, 2015.
- Καφούσιας Νικόλαος. *Ρευστομηχανική Ι*. Πανεπιστημιακές Εκδόσεις Πανεπιστημίου Πατρών, 2002.

(*in English*)

- Elger Donald F., Williams Barbara C., Clayton Crowe T. and Roberson John A. *Engineering Fluid Mechanics*. 10^{th} ed., Wiley, 2012.
- Cengel Yunus A. and Cimbala John M. *Fluid Mechanics: Fundamentals and Applications*. McGraw-Hill, 2006.