4.3 CE0430 – Fluid Mechanics

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	CIVIL ENGINEERING DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**CE0430**	**SEMESTER**	**4**
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*	**WEEKLY TEACHING HOURS**	**CREDITS**
	4	5
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*	Special Background Course
PREREQUISITE COURSES:	Rigid Body Mechanics (CE0120) Calculus & Linear Algebra (CE0110) English level B2 or higher is required for Erasmus incoming students
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (English/Erasmus)
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/CIV170/

(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*

Upon successful completion of the course, the student,

will have understood the principles governing Hydrostatics,

will be able to calculate basic hydrostatic quantities (pressure, pressure vector, distribution of hydrostatic charges on flat and curved surfaces, calculation of recommended hydrostatic force and point of application - pressure center, buoyancy, stability, metacenter),

will have understood the 3 basic balances (mass, energy, linear momentum) as applied in continuous media and especially in liquids,

will have understood the similarities and differences in the behavior of solids, liquids and gases and in particular the basic flow behavior of liquids as a result of their main physical characteristics (density, viscosity) compared to that of solids and gases,

will have understood the meaning of bulk / volumetric supply and its importance in evaluating performance and / or designing and dimensioning any hydraulic system or installation,

will have understood the meaning of the velocity field, the quantities that describe it (flow lines, complex vector derivatives, deviation, curl/swirl) as well as the different types of velocity fields,

will have understood the meaning of the flow tensor,

will have understood the flow behavior of ideal fluids (rheological equations),

will have understood the basic equation governing the motion of fluids (Navier-Stokes equation),

will have understood the phenomenology of flows and relevant classification according to the Reynolds number value (creeping, layered, transient, turbulent flows),

will have acquired the necessary background knowledge for the study of the supplementary course of Hydraulics but also specialization courses of the hydraulic direction of the study program

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	*Search for, analysis and synthesis of data and information, with the use of the necessary technology*
Adapting to new situations	*Adapting to new situations*
Decision-making	*Decision-making*
Working independently	*Working independently*
Team work	*Team work*
Working in an international environment	*Working in an international environment*
Working in an interdisciplinary environment	*Working in an interdisciplinary environment*
Production of new research ideas	*Production of new research ideas*

The course aims that the student acquires - practice the following general skills:

- Search for, analysis of, and synthesis of data and information, implementing appropriate technologies
- Independent work - Team work - Working in an international / interdisciplinary environment
- Decision-taking
- Proact free, creative and inductive thinking

(3) **SYLLABUS**

1. Basic Information - Dimensions, Units, and Physical Quantities; Gases and Liquids; Pressure and Temperature; Properties of Fluids, Thermodynamic Properties and Relationships
2. Fluid Statics - Pressure Variation; Manometers; Forces on Plane and Curved Surfaces; Accelerating Containers
3. Fluids in Motion - Introduction; Fluid Motion; Lagrangian and Eulerian Descriptions (Pathlines, Streaklines, and Streamlines; Acceleration; Angular Velocity and Vorticity); Classification of Fluid Flows; Bernoulli's Equation

4. The Integral Equations - System-to-Control-Volume Transformation; Conservation of Mass; The Energy Equation; The Momentum Equation
5. Differential Equations - The Differential Continuity Equation; The Differential Momentum Equation; The Differential Energy Equation
6. Internal Flows - Entrance Flow; Laminar Flow in a Pipe (The Elemental Approach; Applying the Navier – Stokes Equations; Quantities of Interest); Laminar Flow Between Parallel Plates (The Elemental Approach; Applying the Navier – Stokes Equations; Quantities of Interest); Laminar Flow between Rotating Cylinders (The Elemental Approach; Applying the Navier – Stokes Equations; Quantities of Interest); Turbulent Flow in a Pipe (The Semi-Log Profile; The Power-Law Profile; Losses in Pipe Flow; Losses in Noncircular Conduits; Minor Losses; Hydraulic and Energy Grade Lines); Open Channel Flow

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face in-class teaching. When needed, distance teaching (synchronous/asynchronous)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of I.C.T. in Teaching and Student Communication
TEACHING METHODS *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*	
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.*	Language of evaluation: Greek (English/Erasmus) Written examination, 2,5-hours Problem solving, Multiple choice test, Questions and Answers, Written Essay / Project The evaluation criteria are announced to the students well before the examination; weights per subject /exercise are explicitly indicated. The examination results (including total / partial grading) are announced on the web. Students may require to have access to their tests, they may ask for clarifications on mistakes, grading etc.

Activity	*Semester workload*
In Class (/Distance) Teaching	52
Literature Study	45
Exercises / Paradigms	35
Project assignmenet / Essay	18
Course total	**150**

(5) ATTACHED BIBLIOGRAPHY

Greek Bibliography:

1. Λιακόπουλος Αντ., Μηχανική Ρευστών, 2η Έκδοση, ΕΚΔΟΣΕΙΣ Α. ΤΖΙΟΛΑ & ΥΙΟΙ Α.Ε., 2019, Κωδικός Βιβλίου στον Εύδοξο: 77107657
2. Τερζίδης Γεώργιος Α., Μαθήματα Υδραυλικής, Τόμος 1, Εκδόσεις Ζήτη, 1985, Κωδικός Βιβλίου στον Εύδοξο: 11087
3. HIBBELER R.C., Μηχανική των Ρευστών, Εκδ. ΦΟΥΝΤΑΣ, 2017, Κωδικός Βιβλίου στον Εύδοξο: 59375445

4. Streeter, Wylie, Bedford, Μηχανική των Ρευστών, 1/2009, ISBN 978960330576-7, Εκδ. ΦΟΥΝΤΑΣ, 2009, Κωδικός Βιβλίου στον Εύδοξο: 4300
5. Elger F.D., Williams C. B., CroweT.C., RobersonA. J., Μηχανική Ρευστών, 12η Έκδοση, (επιμέλεια Μιχάλης Σπηλιώτης), ΕΚΔΟΣΕΙΣ Α. ΤΖΙΟΛΑ & ΥΙΟΙ Α.Ε., 2018, Κωδικός Βιβλίου στον Εύδοξο: 77106811
6. Giles, Ranald V., Μηχανική των Ρευστών και Υδραυλική, ΕΣΠΙ ΕΚΔΟΤΙΚΗ ΕΠΕ, 1998, Κωδικός Βιβλίου στον Εύδοξο: 2587
7. Φλυτζάνης Ν. Εισαγωγή στη Μηχανική των Ρευστών [Ηλεκτρονικό Βιβλίο: https://repository.kallipos.gr/handle/11419/5345], 2015

Foreign Bibliography:

1. M. Potter and D.Wiggert, "Schaum's Outline of Fluid Mechanics", 2007, Spronger, DOI : 10.1036/0071487816, ISBN : 0071487816.
2. H. Yamaguchi, "Engineering Fluid Mechanics", Eudoxus Code 73236844, Vol. 85, 2008, ISBN 9781402067426 Springer ebooks, http://dx.doi.org/10.1007/978-1-4020-6742-6
3. G. Hauke, "An Introduction to Fluid Mechanics and Transport Phenomena", Eudoxus code 73228766, 2008 Springer, ISBN 9781402085376, http://dx.doi.org/10.1007/978-1-4020-8537-6