7.13 CE0733 – Introduction to Computational Hydraulics

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	CIVIL ENGINEERING DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**CE0733**	**SEMESTER**	**7**
COURSE TITLE	**Introduction to Computational Hydraulics**		

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**
	3	4
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*	Specialisation Course
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/CIV361/

(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 aim of the course is to give the students fundamental concepts of computational fluid mechanics with applications to Civil Engineering. This course includes computational simulations of one- and two- dimensional flows (Saint-Venant, uniform/non-uniform conditions, steady/unsteady flow regimes, pipe networks, free surface flow), and applications to common hydraulic problems of ordinary differential equations using computational techniques (Monte-Carlo, Simpson, Handy-Cross, Gauss, Euler, Newton-Raphson, Runge-Kutta, RANS) and hydraulic softwares (HEC-RAS, EPANET, OPENFOAM).

Upon completion of the course, students will have:

1. Basic knowledge of computational hydraulic methods and techniques.
2. In-depth knowledge and critical understanding of common hydraulic problems.
3. Knowledge of how to use common hydraulic software.

Specifically, students will be able to:

1. Apply common computational methods (analytical, numerical, probabilistic) to ordinary hydraulic applications (pipe network, gradually varied 1D free surface flow, 2D flood propagation).
2. Apply common numerical techniques (Monte-Carlo, Simpson, Handy-Cross, Gauss, Euler, Newton-Raphson, Runge-Kutta, RANS).
3. Run widely used computational software for hydraulic applications (EPANET, HEC-RAS, OPENFOAM)

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
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…

Specifically, students will be able to perform:

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Decision Making.
- Independent work - Team work - Working in an international / interdisciplinary environment
- Respect for the natural environment - Social, professional and ethical responsibility

(3) SYLLABUS

1. Introduction. Fundamental concepts of basic methods of numerical analysis at Computational Hydraulics, such us: numerical solution of equations or system of equations, linear interpolation, linear regression, numerical integration, optimization methods etc.
2. Application of ordinary differential equations, partial diferrential equations and system of partial differential equations, as well as the appropriate numerical methods to silve them emphasizing to the method of finite differences.
3. Exemplary numerical solution of the aforementioned equations using commercial software (HEC-RAS, EPANET, OPENFOAM) in the following areas: open channel flows, pressurized pipe flows, undergound hydraulics and environmental hydraulics.
4. Introduction to issues related to the uncertainty of numerical models, sources of uncertainty (input data, model parameters, model structure) as well as the methods used to quantify them (Monte Carlo method).

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Teaching using ICT, Communication and Electronic Submission.
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*	see table below

Activity	***Semester workload***
Lectures	39
Classwork	15
Preparation for Project	30
Personal Study	76
Course total	**160**

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.*	The examination is in Greek for resident students. Erasmus students are examined in English. Final written examination (2.5 hours): 60% (Problem- solving, multiple choice test, questions with short answers) Weekly home assignments and/or semester long project: 40% The exam layout is explained to the students well before the examination; weights per subject /exercise are explicitly indicated on the exam form. Examination results (including total grade and grade per subject) are posted on the course e-class site. Students can have access to their exam scripts on request; they may ask for clarifications on mistakes, grading etc.

(5) ATTACHED BIBLIOGRAPHY

Greek Bibliography:

1. Koutitas, Ch. (1982), Computational Hydraulics, PARATIRITIS Publications (in Greek).
2. Tsanis, I. K. (2005), Solved problems of computational hydraulics and environmental engineering. TZIOLAS Publications (in Greek).
3. Soulis, I. (1990), Computational Fluid Mechanics, AIVAZIS Publications (in Greek).

Foreign Bibliography:

1. Szymkiewicz, R. (2010), Numerical Modeling in Open Channel Hydraulics [electronic resource: https://www.springer.com/gp/book/9789048136735], Springer.
2. Rowinski, P. (2011), Experimental Methods in Hydraulic Research [electronic resource: https://www.springer.com/gp/book/9783642174742], Springer.

Related academic journals:

1. Journal of Hydraulic Engineering
2. Journal of Hydraulic Resaerch