COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Naval Architecture		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	NAOME1354	**SEMESTER**	8th
COURSE TITLE	**COMPUTATIONAL SHIP AND MARINE HYDRODYNAMICS**		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**CREDITS (ECTS)**
Lectures	3	4
Laboratory		

COURSE TYPE *general background, specialbackground, specialized, general knowledge, skills development*	Specialized
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/NA203/

(2) COURSE GOALS / LEARNING OUTCOMES

The purpose of the course is the study of fluid dynamics problems through computational methods with applications in Naval Architecture and Marine Technology. In particular, the use of numerical methods is presented to solve the transport equations and evaluate quantities of the flow field. Also, the students are introduced to the use of specialized Computational Fluid Dynamics (CFD) software.

Upon successful completion of the course the students will be able to:

1. Understand the fluid flow equations used in CFD software.
2. Select the appropriate CFD solver for each flow problem.
3. Distinguish and select the appropriate grid depending on the geometry of the problem.
4. Understand and select the appropriate physical and numerical parameters for the CFD solvers.
5. Create appropriate grids using CFD software.
6. Visualize and assess the numerical solution.
7. Combine different software for the numerical solution of flow problems in Naval Architecture applications.

(3) COURSE CONTENT / SYLLABUS

Introduction to Computational Fluid Dynamics. Turbulence, RANS equations, turbulence models, large eddy simulation (LES), direct numerical simulation (DNS).

Numerical solution of transfer equations, convection, diffusion.

Solution of one and two-dimensional flows with finite differences. Examples.

Introduction to finite volume method. SIMPLE, PISO algorithms.

Grids.

Discretization, accuracy, stability, convergence criteria.

Flow visualization and assessment of solution.

CFD applications in Ship and Marine Hydrodynamics. Volume of fluids (VOF) method.

Presentation of specialized software, such as OpenFOAM, ANSYS Fluent and cloud computing (e.g. SimScale) for the solution of fluid dynamics problems.

(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	• Use of ICT in teaching. • Use of specialized CFD software (e.g. OpenFOAM, ANSYS Fluent). • Support learning through the electronic e-class platform.
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*	Written examination (70%) on: • questions of theoretical content • solution of mathematical problems Individual homework assignments (30%) for the numerical solution of the flow field of ship and marine hydrodynamics problems.

Activity	*Workload (hours)*
Lectures	26
Exercises with CFD software	13
Homework assignments	39
Study of Lectures	39
Course total	**117**

(5) ATTACHED BIBLIOGRAPHY

Books

1. Anderson, B. et al, 2012, Computational Fluid Dynamics for Engineers, Cambridge University Press.
2. Chung, T.J., 2010, Computational Fluid Dynamics, 2nd Edition, Cambridge University Press.
3. Anderson, J. D., 1995, Computational Fluid Dynamics, The Basics with Applications, McGraw Hill.
4. Fletcher, C.A.J., 1991, Computational Techniques for Fluid Dynamics, Vol. 1: Fundamental and General Techniques, Springer.
5. Fletcher, C.A.J. 1988, Computational Techniques for Fluid Dynamics 2, Springer.
6. Versteeg H. K., Malalasekera, W., 2007, An Introduction to Computational Fluid Dynamics: The Finite Volume Method (2nd Edition), Pearson; 2 edition.
7. Zikanov O., Essential Computational Fluid Dynamics, 2010, Wiley.

Journals

1. Computers & Fluids, ISSN: 0045-7930
2. European Journal of Mechanics - B/Fluids, ISSN: 0997-7546
3. Journal of Computational Physics, ISSN: 0021-9991