COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Naval Architecture		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	NAOME1253	**SEMESTER**	8th
COURSE TITLE	**NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS**		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS (ECTS)**
Lectures		4	4
COURSE TYPE *general background, specialbackground, specialised general knowledge, skills development*	Special background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/NA241/		

(2) COURSE GOALS / LEARNING OUTCOMES

Many problems in engineering and science are formulated in terms of differential equations. Often, systems described by differential equations are so complex, or the systems that they describe are so large, that they cannot be solved analytically. It is in these complex systems where numerical methods and computer simulations are useful.

The course aims to introduce students into theoretical and practical aspects of numerical methods for differential equations, and to help them to develop practical competence in the numerical solution of various types of differential equations.

Learning outcomes:

On completion of this course the student should be able to:

- Understand the basic principles of the mathematical theory of the finite difference and finite element methods.
- Develop and implement numerical methods for the one-dimensional two-point boundary value problem and for problems described by simple linear partial differential equations.
- Analyze numerical methods and respond to issues such as accuracy, stability and convergence.
- Critically analyze numerical results.
- Understand the advantages and the limitations of the various methods.
- Use the methods in numerical calculations. That is, to be able to implement them on a computer.
- Use and combine these methods to solve naval and marine technology problems.

(3) COURSE CONTENT / SYLLABUS

- **Finite Difference Methods**
  The finite difference method for the two-point boundary value problem. Finite difference methods for parabolic, elliptic and hyperbolic linear partial differential equations. Stability and convergence.
- **Finite Element Method**
  The finite element method for the two-point boundary value problem. Introduction to the finite element method for two-dimensional problems. The concept of the weak formulation for boundary value problems. Basis functions, mass and stiffness matrix. Linear systems solvers. Error estimates.

(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 mathematical software. • 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*	***Activity*** / ***Workload (hours)*** Lectures: 39 Homework assignments: 13 Study of Lectures: 65 Course total: **117**
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*	Final written examination: 70% Three personal assignments: 30%

(5) ATTACHED BIBLIOGRAPHY

1. Morton, K. W., & Mayers, D. F. (2005). Numerical solution of partial differential equations (Second ed.). Cambridge University Press, Cambridge.
2. Larsson, S., & Thomée, V. (2009). Partial differential equations with numerical methods (Vol. 45). Springer-Verlag, Berlin.
3. Johnson, C. (1987). Numerical solution of partial differential equations by the finite element method. Cambridge University Press, Cambridge.
4. Dougalis, V. (2019). Finite element methods for the numerical solution of partial differential equations. (Lecture Notes). Athens.