COURSE OUTLINE

1. GENERAL

SCHOOL	NATURAL SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF COURSE	UNDERGRADUATE		
COURSE CODE	MAT_IC463	**SEMESTER OF STUDIES**	7th
COURSE TITLE	NUMERICAL SOLUTION OF TRANSCENDENTAL EQUATIONS		

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 Laboratories	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 NUMERICAL ANALYSIS
TEACHING AND ASSESSMENT LANGUAGE:	Greek
THE COURSE IS OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBPAGE (URL)	https://eclass.math.upatras.gr/courses/MATH_CMI103/ http://www.math.upatras.gr/~vrahatis/?section=courses

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 completing this course, students will be able to select and apply the most appropriate numerical methods to approximate solutions of transcendental equations and systems of transcendental equations as well as they will further develop the following skills:

- Understanding of various numerical methods for solving transcendental equations and systems of transcendental equations.
- Ability to apply these methods to solve mathematical problems for which there do not exist mathematical closed-form expressions that can be solved analytically as well as *to* apply these methods to tackle real world problems.
- Ability to distinguish the advantages and disadvantages of various methods in order to choose and apply the most appropriate one for a given problem.
- Ability to use the mathematical computing environment Matlab (and/or the General Public License-GNU Octave) to implement the course's methods and algorithms.

After successfully attending the course, the students will be able to approach systematically and provide approximate solutions to solve mathematical problems for which there do not exist mathematical closed-form expressions that can be solved analytically as well as to tackle real world problems by choosing and applying the most appropriate numerical analysis methods.

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…

- Search, analyze and synthesize data and information, using the necessary technologies.
- Decision making.
- Autonomous work.
- Working in an interdisciplinary environment.
- Promote free, creative and inductive thinking.

3. COURSE CONTENT

Concepts of the transcendental functions and their applications. Solutions localization and isolation. Topological degree theory. Methods for computing the topological degree. Methods of Stenger and Kearfott. Existence theorems of Kronecker and Picard. Computing the exact number of solutions. Computing all solutions. Existence of fixed points. Banach's theorem. Theorems of Brouwer and Poincaré-Miranda. Computation of fixed points. Knaster-Kuratowski-Mazurkiewicz covering Lemma. Lemma of Scarf-Hansen. Sperner's Lemma. Triangulations. Scarf's method. Computing solutions of nonlinear systems of algebraic and transcendental equations. Methods of Newton, type Newton, generalized secant, Broyden. Nonlinear methods of Successive Overrelaxation (SOR), Gauss-Seidel and Jacobi. Generalized bisection method. Numerical optimization methods of transcendental functions.

Laboratory exercises using the mathematical computing environment Matlab (and/or the General Public License-GNU Octave) to implement the course's methods and algorithms.

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc*	Face-to-Face Lectures
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in teaching, laboratory education, communication with students*	Support of the learning process through the *eClass* platform. Usage of the mathematical computing environment Matlab (and/or the General Public License-GNU Octave) to implement the course's methods and algorithms.
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*	(see table below)

Activity	***Semester workload***
Lectures	26
Laboratory exercises	26
Solving suggested exercises	30
Personal study by the student	65
Final examination	3
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***150***

STUDENT ASSESSEMNT *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 which includes theory and problems solving. Minimum passing grade: 5 Maximum passing grade: 10

5. RECOMMENDED LITERATURE

(*in Greek*)

- Βραχάτης Μιχαήλ Ν. *Αριθμητική Ανάλυση: Υπερβατικές Εξισώσεις*. Εκδόσεις Κλειδάριθμος, 2012.
- Κεσογλίδης Μιχαήλ. *Βασικά Κεφάλαια Αριθμητικής Ανάλυσης*. Εκδόσεις Ανίκουλα, 2005.