COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES			
ACADEMIC UNIT	DEPARTMENT OF MATHEMATICS			
LEVEL OF STUDIES	POSTGRADUATE **Studies in Mathematics**			
COURSE CODE	**B8**	**SEMESTER**	**B**	
COURSE TITLE	NUMERICAL ANALYSIS			
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**	
		3	10	
COURSE TYPE	SPECIALISED GENERAL KNOWLEDGE (Ordinary and partial differential equations)			
PREREQUISITE COURSES:	NO			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	http://www.math.aegean.gr/index.php/en/academics/undergraduate-programs			

(2) LEARNING OUTCOMES

Learning outcomes
With the completion of this course, the students must have learned and be able to handle numerical methods and techniques for the solution of a big variety of mathematical problems that are encountered in physical sciences, in basic and fundamental research, in industry and in the real-world applications. Special emphasis is given in the development and use of these methods and techniques as well as to their main theoretical characteristics.
General Competences
Working independently Working in an interdisciplinary environment Production of free, creative and inductive thinking

(3) SYLLABUS

1: The basic theory for the numerical solution of non-linear algebraic equations. The contraction mapping theorem. The Newton method for systems of non-linear equations. Analytical and numerical evaluation of function derivatives.

2: Partial differential equations (ODEs) and initial value problems (IVPs). Existence and uniqueness of the solution for IVPs. The methods: Euler, Trapezoidal, Adams-Bashforth, Adams-Moulton, and backwards differentiation. Consistency and stability. Numerical and mathematical instabilities. Stiff equations. The Runge-Kutta and Runge-Kutta-Fehlberg methods.

3: Numerical solution of boundary value problems (BVPs) for ODEs using finite differences and other techniques.

4: Partial differential equations (PDEs) of elliptic, hyperbolic and parabolic type. The finite differences method and the method of lines. Accuracy, stability and convergence. The Lax-equivalence theorem. The Courant-Friedrichs-Lewy criterion. The von-Neumann condition for scalar and vector quantities. The stability of the method of lines. The Alternative Direction Implicit method.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY</td><td>Face-to-face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Communication with students via e-mail</td></tr>
<tr><td>TEACHING METHODS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Independent study</td><td>148,5</td></tr>
<tr><td>Assignments</td><td>62.5</td></tr>
<tr><td>Course total (25 per ECTS)</td><td>250</td></tr>
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<tr><td>STUDENT PERFORMANCE EVALUATION</td><td>Student evaluation is done in Greek through a written examination which includes short-answer equations and problem solving.
For students with disabilities, evaluation takes place via oral exams.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Numerical methods for scientists and engineers, R.W. Hamming, Dover (1962).
2. Introduction to numerical analysis, F.B. Hildebrand, Dover (1956).
3. Finite Differences and spectral methods for ordinary and partial differential equations, Lloyd N. Trefethen, (1996).
4. Theory and applications of numerical analysis, GM Phillips & PJ Taylor, 2nd edition, Academic Press (1996).
5. Applied numerical analysis, C.F. Gerald & P.O. Wheatley, 6th edition, (1999).
6. Numerical partial differential equations, Finite difference methods, J.W. Thomas, Springer, (1995).
7. Numerical partial differential equations, Conservation laws and elliptic equations, J.W. Thomas, Springer, (1999).

- Related academic journals: Acta Numerica, SIAM Journal on Numerical Analysis, International Journal for Numerical methods in Engineering.