

## ETY604 - Numerical Analysis and Applications

### COURSE DESCRIPTION

#### (1) GENERAL COURSE INFORMATION

<b>SCHOOL</b>	SCHOOL OF ENGINEERING		
<b>DEPARTMENT</b>	DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING		
<b>LEVEL OF EDUCATION</b>	UNDERGRADUATE		
<b>COURSE CODE</b>	ETY604	<b>SEMESTER</b>	5
<b>COURSE TITLE</b>	Numerical Analysis and Applications		
<b>TEACHING ACTIVITIES</b> <i>in case the credit units are awarded in distinct parts of the course e.g. Lectures, Laboratory Exercises, etc. If credits are awarded uniformly for the entire course, indicate the weekly teaching hours and the total credits</i>		<b>WEEKLY TEACHING HOURS</b>	<b>CREDIT UNITS</b>
Lectures and Tutorials		3	3
<i>The organization of teaching and the teaching methods used are described in detail below.</i>			
<b>COURSE TYPE</b> <i>general background, special background, specialization, general knowledge, skills development</i>	General Background		
<b>REQUIRED COURSES:</b>	Programming is prerequisite (FORTRAN or C or C++).		
<b>LANGUAGE OF TEACHING AND EXAMINATIONS:</b>	Greek		
<b>THE COURSE IS OFFERED TO ERASMUS STUDENTS:</b>	NO		
<b>COURSE WEBSITE (URL):</b>	<a href="http://medlab.cc.uoi.gr/lessons/numerical_analysis">http://medlab.cc.uoi.gr/lessons/numerical_analysis</a>		

#### (1) LEARNING RESULTS

##### LEARNING RESULTS

*Description of the learning outcomes of the course, the specific knowledge, skills and abilities of the appropriate level that the students will acquire after the successful completion of the course.*

*Consult Appendix A.*

- *Description of the Level of Learning Outcomes for each cycle of studies according to the Qualifications Framework of the European Higher Education Area*
- *Descriptive Levels 6, 7 & 8 of the European Qualifications for Lifelong Learning Framework and Annex B*
- *Summary Learning Outcome Guide*

**Knowledge:** Through the course of "Numerical Analysis and Applications", the student will acquire the necessary background related to the principles of Numerical Analysis and applications. More specifically, numerical methods are provided related to the solution of equations, solution of systems of linear equations, interpolation/extrapolation, finite differences, differentiation, integration. Specific attention is paid to numerical methods which address the use and analysis of measurements and experimental results.

**Skills acquired:** This background will allow the student to use numerical analysis methods using programming languages and other tools (MATLAB).

Specifically, at the end of this course the student may have the following skills:

- Use of numerical methods.
- Use of computers to implement these methods.
- Program in MATLAB
- Use experimental data.
- Utilize existing algorithms to solve problems
- Solve with the aid of a computer simple problems encountered in materials engineering
- Use of libraries with numerical tools

Theoretical principles of numerical methods are presented as well as examples implemented in MATLAB.

#### **General Abilities**

*Taking into account the general skills that the graduate must have acquired (as they are listed in the Diploma Supplement and are listed below)*

*Search, analyze and compose data and information, using the necessary technologies*

*Adaptation to new situations*

*Decision making*

*Autonomous work*

*Teamwork*

*Work in an international environment*

*Work in an interdisciplinary environment*

*Production of new research ideas*

*Project design and management*

*Respect for diversity and multiculturalism*

*Respect for the natural environment*

*Demonstration of social, professional and moral responsibility and sensitivity on gender issues*

*Practice criticism and self-criticism*

*Promoting free, creative and inductive thinking*

*.....*

*Others.....*

#### **Specific skills**

- Search, analyze and compose data and information, using the necessary technologies
- Autonomous work
- Practice criticism and self-criticism
- Promoting free, creative and inductive thinking
- Work in an interdisciplinary environment

## **(2) CONTENT OF COURSE**

Numerical Analysis and Applications is a compulsory subject for students of the Department of Materials Science and Engineering of the University of Ioannina. The course includes introductory topics related to numerical analysis and covers most of its sub topics. Similar courses are offered at all Universities abroad, both on an undergraduate and graduate level. The teaching of the course is based on the international experience and the existing experience in the Department of Materials Science and Engineering, and includes the following :

- Calculations and Errors in Numerical Analysis
- Solution of Systems of Linear Equation
- The Finite Difference Method
- Numerical Solution of Equations
- Interpolation and Extrapolation
- Numerical Differentiation
- Numerical Integration

## **(3) TEACHING AND LEARNING METHODS - EVALUATION**

<b>TEACHING METHOD.</b>	Face to face/ Lab
<b>USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES</b>	-In teaching -In communication with the students -In the course web site

<p>Use of Information and Communication Technology (ICT) in Teaching, in Laboratory Education, in Communication with students</p>	<p>-In the implementation of homeworks -Laboratory exercises include implementation of numerical methods in MATLAB</p>	
<p><b>ORGANIZATION OF TEACHING</b> <i>The teaching methods are described in detail. Lectures, Seminars, Laboratory Exercise, Field Exercise, Study &amp; analysis of bibliography, Tutoring, Practice (Installation), Clinical Exercise, Artistic Workshop, Interactive teaching, Creative work, Artistic working visits / Writing, Project study. etc.</i></p> <p><i>The study hours of the student for each learning activity are listed as well as the hours of non-guided study according to the principles of ECTS</i></p>	<p><b>Activity</b></p>	<p><b>Semester Workload</b></p>
	<p>Lectures</p>	<p>39</p>
	<p>Tutorial</p>	<p>13</p>
	<p>Assignment Writing</p>	<p>24</p>
	<p></p>	<p></p>
	<p></p>	<p></p>
	<p></p>	<p></p>
<p></p>	<p></p>	
<p>Course total</p>	<p>75</p>	
<p><b>STUDENT EVALUATION</b> <i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Test Development Questions, Problem Solving, Written Work, Job Search, Job Search / Reference, Oral Examination, Oral Examination Others</i></p> <p><i>There are explicitly defined assessment criteria and if and where they are accessible to students.</i></p>	<p>The evaluation language is Greek.</p> <p>Three sets of homeworks are planned counting for 30% of the total.</p> <p>The students are evaluated through a presentation of a method of numerical analysis, which includes, description, methodology, algorithm, examples and literature.</p> <p>Or through a final written exam which includes five problems.</p>	

#### (4) RECOMMENDED BIBLIOGRAPHY

##### -Suggested bibliography:

- -M.N. Βραχάτης, Αριθμητική Ανάλυση, Κλειδάριθμος, 2012.
- -Ι.Σαρρής και Θ. Καρακασσιδης, Αριθμητικές Μέθοδοι και Εφαρμογές για Μηχανικούς, Εκδόσεις Τζιόλα, 2013
- R.L. Burden and J.D. Faires, Numerical Analysis, Brooks/Cole, Publishing Company, New York, 1997.
- -G.E. Forsythe, M.A. Malcolm and C.B. Moler, Αριθμητικές Μέθοδοι και Προγράμματα για μαθηματικούς υπολογισμούς, Μετάφραση: Δ.Δ. Ακρίβης και Β.Α. Δουγαλής, Πανεπιστημιακές Εκδόσεις Κρήτης, Ηράκλειο, 1994.
- -W.H. Press, S.A. Teukolsky, W.T. Vetterling and B.P. Flannery, Numerical Recipes, the Art of Scientific Computing, (second edition), Cambridge University Press, New York, 1992.

##### -Related academic journals: