COURSE OUTLINE

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE646**	**SEMESTER**	**6**
COURSE TITLE	Techniques of Mathematical Modelling		

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
	3	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*	Special background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	

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*

The course is a first introduction to the basic methods of applied mathematics and particularly in perturbation theory. There are many situations in mathematics where one finds expressions that cannot be calculated with absolute precision, or where exact answers are too complicated to provide useful information. In many of these cases, it is possible to find a relatively simple expression which, in practice, is just as good as the complete, exact

solution. The asymptotic analysis deals with methods for finding such approximations and has a wide range of applications, both in the fields of pure mathematics such as combinatorics, probability, number theory and applied mathematics and computer science, for example, the analysis of runtime algorithms. The goal of this course is to introduce some of the basic techniques and to apply these methods to a variety of problems.

Upon completion of this course students will be able to:

- Recognize the practical value of small or large parameters for calculating mathematical expressions.
- Understand the concept of (divergent) asymptotic series, and distinguish between regular and singular perturbations.
- Find dominant behaviors in algebraic and differential equations with small and large parameters.
- Calculate dominant behavior of integrals with a small parameter.
- Find a (in particular cases) the full asymptotic behavior of integrals.
- Identify the boundary layers in solutions of differential equations, and apply appropriate expansions to calculate the dominant solutions.

General Competences

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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*Others*
Production of new research ideas	

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making

SYLLABUS

- Introduction and notation of perturbation theory
- Regular and singular perturbations
- Asymptotic expansions of integrals
- Asymptotic solutions of linear and nonlinear differential equations
- Laplace and Fourier transforms (if time permits)

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	In class
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory*	

<table>
<tr><td>education, communication with students</td><td></td></tr>
<tr><td>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</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>33</td></tr>
<tr><td>Applications in the computer’s lab</td><td>6</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>39</td></tr>
</table>
</td></tr>
<tr><td>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
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Written exam</td></tr>
</table>

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Related academic journals:

- D. J. Logan, *Εφαρμοσμένα Μαθηματικά*, Πανεπιστημιακές Εκδόσεις Κρήτης, 2010.
- Γ. Δάσιος, *Δέκα Διαλέξεις Εφαρμοσμένων Μαθηματικών*, Πανεπιστημιακές Εκδόσεις Κρήτης, 2001.
- C. M. Bender, S. A. Orszag, Advanced Mathematical Methods for Scientists and Engineers: Asymptotic Methods and Perturbation Theory, Springer, 1999.
- E. J. Hinch, Perturbation Methods, Cambridge University Press, 1991.
- A. H. Nayfeh, Perturbation Methods, Wiley-Interscience, 1973.