

## COURSE OUTLINE

### (1) GENERAL

<b>SCHOOL</b>	SCIENCE		
<b>ACADEMIC UNIT</b>	DEPARTMENT OF MATHEMATICS		
<b>LEVEL OF STUDIES</b>	POSTGRADUATE <b>Studies in Mathematics</b>		
<b>COURSE CODE</b>	<b>313-1205</b>	<b>SEMESTER</b>	<b>A</b>
<b>COURSE TITLE</b>	WEAK SOLUTIONS THEORY		
<b>INDEPENDENT TEACHING ACTIVITIES</b> <i>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</i>		<b>WEEKLY TEACHING HOURS</b>	<b>CREDITS</b>
		3	10
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
<b>COURSE TYPE</b> <i>general background, special background, specialised general knowledge, skills development</i>	SPECIALISED GENERAL KNOWLEDGE		
<b>PREREQUISITE COURSES:</b>	NO		
<b>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</b>	GREEK		
<b>IS THE COURSE OFFERED TO ERASMUS STUDENTS</b>	YES		
<b>COURSE WEBSITE (URL)</b>	<a href="http://www.samos.aegean.gr/samos_math/pms/lessonseng.php">http://www.samos.aegean.gr/samos_math/pms/lessonseng.php</a>		

### (2) LEARNING OUTCOMES

<p><b>Learning outcomes</b></p> <p><i>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.</i></p> <p><i>Consult Appendix A</i></p> <ul style="list-style-type: none"> <li>• <i>Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</i></li> <li>• <i>Descriptors for Levels 6, 7 &amp; 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</i></li> <li>• <i>Guidelines for writing Learning Outcomes</i></li> </ul>																		
<p>Mastering the material described in the syllabus (see (3) below).</p>																		
<p><b>General Competences</b></p> <p><i>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?</i></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"><i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i></td> <td style="width: 50%; border: none;"><i>Project planning and management</i></td> </tr> <tr> <td style="border: none;"><i>Adapting to new situations</i></td> <td style="border: none;"><i>Respect for difference and multiculturalism</i></td> </tr> <tr> <td style="border: none;"><i>Decision-making</i></td> <td style="border: none;"><i>Respect for the natural environment</i></td> </tr> <tr> <td style="border: none;"><i>Working independently</i></td> <td style="border: none;"><i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i></td> </tr> <tr> <td style="border: none;"><i>Team work</i></td> <td style="border: none;"><i>Criticism and self-criticism</i></td> </tr> <tr> <td style="border: none;"><i>Working in an international environment</i></td> <td style="border: none;"><i>Production of free, creative and inductive thinking</i></td> </tr> <tr> <td style="border: none;"><i>Working in an interdisciplinary environment</i></td> <td style="border: none;"><i>.....</i></td> </tr> <tr> <td style="border: none;"><i>Production of new research ideas</i></td> <td style="border: none;"><i>Others...</i></td> </tr> <tr> <td style="border: none;"></td> <td style="border: none;"><i>.....</i></td> </tr> </table>	<i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i>	<i>Project planning and management</i>	<i>Adapting to new situations</i>	<i>Respect for difference and multiculturalism</i>	<i>Decision-making</i>	<i>Respect for the natural environment</i>	<i>Working independently</i>	<i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i>	<i>Team work</i>	<i>Criticism and self-criticism</i>	<i>Working in an international environment</i>	<i>Production of free, creative and inductive thinking</i>	<i>Working in an interdisciplinary environment</i>	<i>.....</i>	<i>Production of new research ideas</i>	<i>Others...</i>		<i>.....</i>
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<p>Working independently</p>																		

Team work  
Working in an interdisciplinary environment

### (3) SYLLABUS

Sobolev spaces: Weak derivative and the definition of Sobolev spaces. Approximation by smooth functions. Extension Theorem. Trace. Inequalities of Gagliardo—Nirenberg—Sobolev, Morrey and Poincare. Compactness. Lipschitz functions and differentiability almost everywhere. Sobolev spaces and the Fourier transform. The dual space. Spaces involving time.

Elliptic equations: Weak solutions, Lax-Milgram theorem. Energy estimates. Fredholm alternative. Regularity. Hopf's Lemma, maximum principle. De Giorgi-Moser theory, Harnack inequality. Eigenvalue Problem.

Parabolic equations: Weak solution, Galerkin's method. Energy estimates. Regularity. Maximum principle. Harnack inequality.

Hyperbolic equations: Weak solution, Galerkin's method. Energy estimates. Regularity.

Semigroup theory and applications.

### (4) TEACHING and LEARNING METHODS - EVALUATION

<b>DELIVERY</b> <i>Face-to-face, Distance learning, etc.</i>	Face-to-face	
<b>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</b> <i>Use of ICT in teaching, laboratory education, communication with students</i>	<ul style="list-style-type: none"> <li>• Communication with students via e-mail</li> <li>• Uploading course material on moodle system</li> </ul>	
<b>TEACHING METHODS</b> <i>The manner and methods of teaching are described in detail.</i> <i>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.</i>  <i>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</i>	<b>Activity</b>	<b>Semester workload</b>
	Lectures	39
	Independent study	148.5
	Assignments	62.5
	Course total (25 per ECTS)	<b>187.5</b>
<b>STUDENT PERFORMANCE EVALUATION</b> <i>Description of the evaluation procedure</i>  <i>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</i>  <i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i>	<p>Student evaluation is done in Greek through a written examination which includes short-answer equations and problem solving.</p> <p>For students with disabilities, evaluation takes place via oral exams.</p>	

### (5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. L. C. Evans, *Partial differential equations*. Second edition. Graduate Studies in Mathematics, 19. American Mathematical Society, Providence, RI, 2010. xxii+749 pp. ISBN: 978-0-8218-4974-3.
2. D. Gilbarg & N. Trudinger, *Elliptic partial differential equations of second order*. Reprint of the 1998 edition. Classics in Mathematics. Springer-Verlag, Berlin, 2001. xiv+517 pp. ISBN: 3-540-41160-7 .
3. G.M. Lieberman, *Second order parabolic differential equations*. World Scientific Publishing Co., Inc., River Edge, NJ, 1996. xii+439 pp. ISBN: 981-02-2883-X.
4. H. Brezis, *Functional analysis, Sobolev spaces and partial differential equations*. Universitext. Springer, New York, 2011. xiv+599 pp. ISBN: 978-0-387-70913-0.
5. J. Jürgen, *Partial differential equations*. Third edition. Graduate Texts in Mathematics, 214. Springer, New York, 2013. xiv+410 pp. ISBN: 978-1-4614-4808-2; 978-1-4614-4809-9.
6. V. Maz'ya, *Sobolev spaces with applications to elliptic partial differential equations*. Second, revised and augmented edition. Fundamental Principles of Mathematical Sciences, 342. Springer, Heidelberg, 2011. xxviii+866 pp. ISBN: 978-3-642-15563-5.
7. Q. Han & F. Lin, *Elliptic partial differential equations*. Second edition. Courant Lecture Notes in Mathematics, 1. American Mathematical Society, Providence, RI, 2011. x+147 pp. ISBN: 978-0-8218-5313-9

- Related academic journals: Journal of Differential Equations, Communications in Partial Differential Equations