

Course Outlines

Postgraduate Program “APPLIED MATHEMATICS”

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APPLIED FUNCTIONAL ANALYSIS

2. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
DEPARTMENT	CIVIL ENGINEERING		
LEVEL OF STUDIES	POST-GRADUATE, LEVEL 7		
COURSE CODE		SEMESTER	1 st SEMESTER
COURSE TITLE	APPLIED FUNCTIONAL ANALYSIS		
TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>		TEACHING HOURS PER WEEK	ECTS CREDITS
		3	7,5
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	Scientific Area		
PREREQUISITES:	None		
TEACHING & EXAMINATION LANGUAGE:	Greek		
COURSE OFFERED TO ERASMUS STUDENTS:	No		
COURSE URL:	https://eclass.duth.gr/courses/TMB291/		

2. LEARNING OUTCOMES

Learning Outcomes <i>Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.</i>
<p>Learning outcomes in Applied Functional Analysis</p> <p>Upon successful completion of the course, students will be able to:</p> <ul style="list-style-type: none"> - Understand the basic properties of metrics. - Prove simple results in metric spaces, which are essentially generalizations of absolute value. - Understand the concept of topological non-metric spaces.

- To formulate problems from other areas of mathematics, such as the fixed point theorem, in differential equations,
- Understand that series integration and derivation are essentially inference of uniform convergence of a sequence of functions.
- To understand the importance of non-metric spaces and their applications in various sciences, such as physics

General Skills

Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information,

Project design and management

ICT Use

Equity and Inclusion

Adaptation to new situations

Respect for the natural environment

Decision making

Sustainability

Autonomous work

Demonstration of social, professional and moral responsibility and sensitivity to gender issues

Teamwork

Critical thinking

Working in an international environment

Promoting free, creative and inductive reasoning

Working in an interdisciplinary environment

Production of new research ideas

Search, analysis and synthesis of data and information, ICT Use.

Adaptation to new situations.

Decision making.

Autonomous work.

3. COURSE CONTENT

1. Real numbers (Limits and continuity)
2. Countable and non-countable sets.
3. Metric spaces with norm and their properties
4. Continuity of a function
5. Sequences in metric spaces
6. Convergence of function sequences (point convergence, uniform convergence, the space of terminated functions)
7. The space of continuous functions
8. Topological spaces

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD

Face to face, Distance learning, etc.

Live distance learning

<p align="center">USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT)</p> <p align="center"><i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i></p>	<p>Use of ICT in teaching and in communication with the students</p>													
<p align="center">TEACHING ORGANIZATION</p> <p><i>The ways and methods of teaching are described in detail.</i></p> <p><i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i></p> <p><i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i></p>	<table border="1"> <thead> <tr> <th align="center"><i>Activity</i></th> <th align="center"><i>Workload/semester</i></th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td align="center">39</td> </tr> <tr> <td>Bibliographicalresearchandstudy</td> <td align="center">78</td> </tr> <tr> <td>Assignmentsduringthecourse</td> <td align="center">30</td> </tr> <tr> <td>Finalwritten exam</td> <td align="center">3</td> </tr> <tr> <td>Total</td> <td align="center">150</td> </tr> </tbody> </table>		<i>Activity</i>	<i>Workload/semester</i>	Lectures	39	Bibliographicalresearchandstudy	78	Assignmentsduringthecourse	30	Finalwritten exam	3	Total	150
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Total	150													
<p align="center">STUDENT EVALUATION</p> <p><i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</i></p> <p><i>Please indicate all relevant information about the course assessment and how students are informed</i></p>	<p>Assignments during the course.</p> <p>Final written exam.</p>													

5. SUGGESTED BIBLIOGRAPHY

1. N. L. Carothers, (2006), "Real Analysis", Cambridge University Press.

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Emeritus Prof. Basil Papadopoulos
Contact details:	Email: papadob@civil.duth.gr , Telephone: +30 25410 79747
Supervisors: (1)	No
Evaluation methods: (2)	Students are evaluated via written assignments during the course and a written final assignment.
Implementation Instructions: (3)	The course is given via live distance learning and emergency situations will not affect lectures and student evaluation.

(1) Please write YES or NO

(2) Note down the evaluation methods used by the teacher, e.g.

- *written assignment* or/and exercises
- written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(3) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.

SPECIAL TOPICS IN DIFFERENTIAL AND DIFFERENCE EQUATIONS

1. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
DEPARTMENT	CIVIL ENGINEERING		
LEVEL OF STUDIES	POST-GRADUATE, LEVEL 7		
COURSE CODE		SEMESTER	1 st SEMESTER
COURSE TITLE	SPECIAL TOPICS IN DIFFERENTIAL AND DIFFERENCE EQUATIONS		
TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>		TEACHING HOURS PER WEEK	ECTS CREDITS
		3	7,5
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	Scientific Area		
PREREQUISITES:	None		
TEACHING & EXAMINATION LANGUAGE:	Greek		
COURSE OFFERED TO ERASMUS STUDENTS:	No		
COURSE URL:	https://eclass.duth.gr/courses/TMB292/		

2. LEARNING OUTCOMES

Learning Outcomes <i>Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.</i>
<p>After the successful completion of this course, the post-graduate students will be able:</p> <ul style="list-style-type: none"> • To apply methods like “separation of variables” • To solve partial differential equations • To solve boundary-initial value problems • To study the asymptotic behavior of the solutions of difference equations • To study the boundedness, the convergence and the stability of difference equations
General Skills <i>Name the desirable general skills upon successful completion of the module</i>

<i>Search, analysis and synthesis of data and information,</i>	<i>Project design and management</i>
<i>ICT Use</i>	<i>Equity and Inclusion</i>
<i>Adaptation to new situations</i>	<i>Respect for the natural environment</i>
<i>Decision making</i>	<i>Sustainability</i>
<i>Autonomous work</i>	<i>Demonstration of social, professional and moral responsibility and sensitivity to gender issues</i>
<i>Teamwork</i>	<i>Critical thinking</i>
<i>Working in an international environment</i>	<i>Promoting free, creative and inductive reasoning</i>
<i>Working in an interdisciplinary environment</i>	
<i>Production of new research ideas</i>	

<ul style="list-style-type: none"> – Search, analysis and synthesis of data and information, ICT Use. – Adaptation to new situations. – Decision making. – Autonomous work.

3. COURSE CONTENT

PART A: Basic theory of Ordinary and Partial Differential Equations. Method of Separation of variables. Initial and boundary value problems. The wave equation. The heat equation. The potential equation (Laplace equation). The wave equation in two dimensions. The overlapping principle. The heat equation in three dimensions. Bessel functions. Spherical harmonic coordinates. Legendre polynomials. The Laplace equation in three dimensions. Linear vector spaces. Inner product. Linear subspaces.

PART B: Basic theory of difference equations, Linear difference equations of first order, Linear homogenous difference equations with constant coefficients, Linear non-homogenous difference equations: Method of undetermined coefficients, The method of variation of constants, Systems of difference equations, Fixed points (Equilibrium points) of a difference equation of first order: Hyperbolic fixed points, Nonhyperbolic fixed points, Stability of a hyperbolic fixed point, Stability of a nonhyperbolic fixed point, Stability of linear systems, Stability of difference equations of second order: Stability of a hyperbolic fixed point via linearization, Central manifolds, Stability of a nonhyperbolic fixed point via the central manifold, Attractivity of fixed points, Applications of difference equations in Population Dynamics, Biomathematics.

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD <i>Face to face, Distance learning, etc.</i>	Live distance learning	
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) <i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i>	Use of ICT in teaching and in communication with the students	
TEACHING ORGANIZATION <i>The ways and methods of teaching are described in detail.</i> <i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning,</i>	Activity	Workload/semester
	Lectures	39
	Bibliographical research and study	78
	Assignments during the course	30
	Final written exam	3
	Total	150

<p><i>Study visits, Study / creation, project, creation, project. Etc.</i></p> <p><i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i></p>	
<p>STUDENT EVALUATION</p> <p><i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</i></p> <p><i>Please indicate all relevant information about the course assessment and how students are informed</i></p>	<p>Assignments during the course.</p> <p>Final written exam.</p>

5. SUGGESTED BIBLIOGRAPHY

1. R. P. Agarwal, Difference equations and inequalities, Marcel Dekker, New York, 1992.
2. E. Camouzis and G. Ladas, Dynamics of Third-Order Rational Difference Equations with Open Problems and Conjectures, Chapman & Hall/CRC, Boca Raton, London, 2008.
3. L. Edelstein-Keshet, Mathematical Models in Biology, Birkhauser Mathematical Series, NY, 1988
4. S. Elaydi, An introduction to Difference Equations, Springer-Verlag, New York, 1996.
5. E. A. Grove and G. Ladas, Periodicities in Nonlinear Difference Equations, Chapman & Hall/CRC, 2005.
6. V. L. Kocic and G. Ladas, Global behavior of nonlinear difference equations of higher order with applications, Kluwer Academic Publishers, Dordrecht, 1993.
7. M. R. S. Kulenovic and G. Ladas, Dynamics of Second Order Rational Difference Equations, Chapman & Hall/CRC, 2002.
8. L. C. Andrews, Elementary PDE's with Boundary Value Problems, Academic Press Inc..
9. H. Sagan, Boundary Eigenvalue Problems in Mathematical Physics, Dover Publications, Inc..
10. I. N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill Kogakusha, Ltd..

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Prof. Christos Schinas Prof. Garyfalos Papaschinopoulos
Contact details:	Email: cschinas@ee.duth.gr , Telephone: +30 25410 79763 Email: gpapas@env.duth.gr , Telephone: +30 25410 79758
Supervisors: (1)	No
Evaluation methods: (2)	Students are evaluated via written assignments during the course and a written final assignment.
Implementation Instructions: (3)	The course is given via live distance learning and emergency situations will not affect lectures and student evaluation.

(4) Please write YES or NO

(5) Note down the evaluation methods used by the teacher, e.g.

6. *written assignment* or/and exercises

7. written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(6) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.

ARTIFICIAL INTELLIGENCE

1. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
DEPARTMENT	CIVIL ENGINEERS / Msc Applied Mathematics		
LEVEL OF STUDIES	Msc – Level 7		
COURSE CODE		SEMESTER	1 st SEMESTER
COURSE TITLE	ARTIFICIAL INTELLIGENCE		
TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>		TEACHING HOURS PER WEEK	ECTS CREDITS
		3	7,5
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	SCIENTIFIC AREA		
PREREQUISITES:	NO		
TEACHING & EXAMINATION LANGUAGE:	GREEK		
COURSE OFFERED TO ERASMUS STUDENTS:	NO		
COURSE URL:	https://eclass.duth.gr/courses/TMA529/		

2. LEARNING OUTCOMES

Learning Outcomes

Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.

The aim of the course is to provide students with the necessary theoretical documentation of the topics being developed and familiarize them, through group or individual assignments, with how to use the basic tools of artificial intelligence in various fields of application. This provides an in-depth understanding of the core concepts of the course.

More specifically, at the end of the course the student

1. Knows what artificial/computational intelligence is.

2. Knows how to solve problems through solution search techniques and their most important algorithms.
3. Knows about genetic algorithms and how to apply them to various problems
3. Knows the operation of biological and artificial neural networks (ANNs) and especially multi-layer feedforward ANNs.
4. Knows the basic concepts and algorithms of machine learning
5. Knows how to solve problems in the above areas of knowledge.

By participating in the exercises and carrying out individual tasks, the student implements and applies the basic knowledge of the course to selected problems using specialized educational software. At the end of the course the student will have developed the following skills:

1. Ability to choose the most appropriate method of solving problems that require the use of artificial intelligence techniques.
2. Ability to use and program specialized software to apply artificial neural networks, genetic algorithms and techniques for finding solutions to problems found in various fields of science

General Skills

Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information, Project design and management

ICT Use Equity and Inclusion

Adaptation to new situations Respect for the natural environment

Decision making Sustainability

Autonomous work Demonstration of social, professional and moral responsibility and sensitivity to gender issues

Teamwork Critical thinking

Working in an international environment Promoting free, creative and inductive reasoning

Production of new research ideas

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Autonomous work.
- Production of free, creative and inductive thinking.
- Decision making.

3. COURSE CONTENT

Definitions and applications of artificial intelligence. Problem representation and solving, solution search techniques (Blind search algorithms, heuristics, guided search algorithms, game playing, nature inspired algorithms). Evolutionary computations (Introduction to genetic algorithms (GA), finding solutions and optimization using GA, applications). Introduction to machine learning and artificial neural networks (Basic concepts in neural

computing, biological and artificial neurons, basic ANN structures and models, learning processes, the back-propagation algorithm and learning agents, other types of ANN).

4. LEARNING & TEACHING METHODS - EVALUATION

<p>TEACHING METHOD <i>Face to face, Distance learning, etc.</i></p>	Synchronous distance learning									
<p>USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) <i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i></p>	<p>The lectures of the course are done using the Microsoft Powerpoint program. MsTeams/ e-class, webmail are also used. When required, the internet connection is used during the course, when reference is made to material from various websites or a presentation of appropriate learning material is deemed necessary.</p> <p>Specialized software is used to teach programming exercises. The e-Class is used to post the educational material and assignments (in electronic format), as well as to inform and guide the students. Theory and exercises are taught with demonstrative use of software. Communication with students is done via e-mail, e-Class</p>									
<p>TEACHING ORGANIZATION <i>The ways and methods of teaching are described in detail.</i></p> <p><i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i></p> <p><i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i></p>	<table border="1"> <thead> <tr> <th data-bbox="694 1025 1029 1066"><i>Activity</i></th> <th data-bbox="1034 1025 1361 1066"><i>Workload/semester</i></th> </tr> </thead> <tbody> <tr> <td data-bbox="694 1066 1029 1104">Lectures</td> <td data-bbox="1034 1066 1361 1104">39</td> </tr> <tr> <td data-bbox="694 1104 1029 1142">Assignments per module</td> <td data-bbox="1034 1104 1361 1142">63</td> </tr> <tr> <td data-bbox="694 1142 1029 1211">Literature study and analysis</td> <td data-bbox="1034 1142 1361 1211">78</td> </tr> </tbody> </table>		<i>Activity</i>	<i>Workload/semester</i>	Lectures	39	Assignments per module	63	Literature study and analysis	78
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Assignments per module	63									
Literature study and analysis	78									
<p>STUDENT EVALUATION <i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</i></p> <p><i>Please indicate all relevant information about the course assessment and how students are informed</i></p>	<p>Homework per subject unit (mandatory) 100%. They are combined with oral exams on the assignments and the subject unit they cover</p>									

5. SUGGESTED BIBLIOGRAPHY

-ΥΠΟΛΟΓΙΣΤΙΚΗ ΝΟΗΜΟΣΥΝΗ ΚΑΙ ΕΦΑΡΜΟΓΕΣ Μπούταλης Ι., Συρακούλης Γ. Εκδόσεις Κρίκος, ΑΦΟΙ ΠΑΠΑΜΑΡΚΟΥ ΟΕ
 -ΤΕΧΝΗΤΗ ΝΟΗΜΟΣΥΝΗ Ι. Βλαχάβας, Π. Κεφαλάς, Ν. Βασιλειάδης, Φ. Κόκκορας, Η. Σακελλαρίου, ΕΤΑΙΡΙΑ ΑΞΙΟΠΟΙΗΣΗΣ ΚΑΙ ΔΙΑΧΕΙΡΙΣΗΣ ΠΕΡΙΟΥΣΙΑΣ ΤΟΥ ΠΑΝΕΠΙΣΤΗΜΙΟΥ ΜΑΚΕΔΟΝΙΑΣ
 -ΥΠΟΛΟΓΙΣΤΙΚΗ ΝΟΗΜΟΣΥΝΗ & ΕΥΦΥΕΙΣ ΠΡΑΚΤΟΡΕΣ Ηλιάδης Λ., Παπαλεωνίδας Α,. Εκδόσεις Τζιόλα

Relative Scientific Journals:

- IEEE Transactions on Intelligent Systems
- IEEE Transactions on Fuzzy Systems
- Neurocomputing

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	IOANNIS BOUTALIS
Contact details:	ybout@ee.duth.gr
Supervisors: (1)	NO
Evaluation methods: (2)	Homework (100%)
Implementation Instructions: (3)	Homework should be submitted via eclass on specified dates. Oral exams follow for each assignment and the related material unit

(7) Please write YES or NO

(8) Note down the evaluation methods used by the teacher, e.g.

6. *written assignment* or/and exercises

7. written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(9) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.

FINITE ELEMENTS

1. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
DEPARTMENT	CIVIL ENGINEERING		
LEVEL OF STUDIES	GRADUATE PROGRAM LEVEL 7		
COURSE CODE		SEMESTER	1 st SEMESTER
COURSE TITLE	FINITE ELEMENTS		
TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>	TEACHING HOURS PER WEEK	ECTS CREDITS	
	3	7,5	
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	SCIENTIFIC AREA		
PREREQUISITES:	NONE		
TEACHING & EXAMINATION LANGUAGE:	GREEK		
COURSE OFFERED TO ERASMUS STUDENTS:	NO		
COURSE URL:	https://eclass.duth.gr/courses/TMB299/		

2. LEARNING OUTCOMES

Learning Outcomes <i>Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.</i>
<p>Upon successful completion of the course, participants will be in a position to:</p> <ul style="list-style-type: none"> • understand the underpinning mathematical principles, the algorithmic structure, the adjoining tools from numerical analysis, and the layout of computer implementation for methods of weighted residuals, with particular emphasis on the method of finite elements, which is the method most widely employed. • use effectively any commercial software of finite elements, based on their knowledge of the significance of, and interactions among and, hence, the proper ways of employing and leveraging the numerous tools and settings, made available to them by such software.

- judge which models are well-defined in mathematical and numerical terms (and which are not) and to critically assess the qualitative and quantitative characteristics of computational results obtained.

General Skills

Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information, Project design and management

ICT Use Equity and Inclusion

Adaptation to new situations Respect for the natural environment

Decision making Sustainability

Autonomous work Demonstration of social, professional and moral responsibility and sensitivity to gender issues

Teamwork Critical thinking

Working in an international environment Promoting free, creative and inductive reasoning

Working in an interdisciplinary environment

Production of new research ideas

- Working in an interdisciplinary environment
- Search, analysis and synthesis of data and information, with ICT use
- Project design and management (with emphasis on use of mathematical models)
- Promoting free, creative and inductive reasoning
- Generating new research ideas

3. COURSE CONTENT

The course comprises a review of the principles, techniques and advantages of the Finite Element Method (*FEM*), with emphasis on its mathematical background, as well as of the computer implementation of the FEM, with emphasis on algorithmic generality and on taking advantage of array operations.

The course also covers in detail (mathematical derivation and computer implementation):

1. the transformation from strong-form differential problems to equivalent weak-form integro-differential problems,
2. the kinds of loads and boundary conditions and how they are handled,
3. 1-D and multidimensional shape functions and their derivation,
4. analytical integration or numerical quadrature of elements to produce work-equivalent nodal “load” vector as well as stiffness matrix and (consistent) mass matrix,
5. the assembly and solution of the global system of equations,
6. the post-processing to obtain “action effects” and support design.

The course also serves as an introduction to more specialized topics, such as:

1. solution of very large and very sparse linear systems (vector methods, preconditioning, incomplete factorizations, etc.),
2. constitutive and geometric nonlinearity and incremental techniques for solving nonlinear problems,
3. dynamic problems and time-integration,

4. constrained problems and multiple incompatible fields (selective and partial integration, mixed formulations), and the like.

4. LEARNING & TEACHING METHODS - EVALUATION

<p style="text-align: center;">TEACHING METHOD</p> <p style="text-align: center;"><i>Face to face, Distance learning, etc.</i></p>	Synchronous remote instruction	
<p style="text-align: center;">USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT)</p> <p style="text-align: center;"><i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i></p>	Use of ICT in Teaching and Communication with the students	
<p style="text-align: center;">TEACHING ORGANIZATION</p> <p><i>The ways and methods of teaching are described in detail.</i></p> <p><i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i></p> <p><i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i></p>	Activity	Workload/semester
	Lectures	39
	Homework assignments	75
	Literature study and review	25
	Exams	11
	Course Total	150
<p style="text-align: center;">STUDENT EVALUATION</p> <p><i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</i></p> <p><i>Please indicate all relevant information about the course assessment and how students are informed</i></p>	Homework assignments (compulsory) 80%	
	Regarding the mathematical formulation of simple finite-element models and the concise and efficient implementation of selected tools of the FEM (by leveraging array operations).	
	Short written exam	20%

5. SUGGESTED BIBLIOGRAPHY

1. Χ. Προβατίδης, «Πεπερασμένα Στοιχεία στην Ανάλυση Κατασκευών», Τζιόλα, 2016.
2. Μ. Παπαδρακάκης, «Ανάλυση Φορέων με την Μέθοδο των Πεπερασμένων Στοιχείων», Παπασωτηρίου, 2001.
3. Γ. Τσαμασφύρος και Ε. Θεοτόκογλου, «Η Μέθοδος των Πεπερασμένων Στοιχείων – Τόμος Ι», Συμμετρία, 2005.
4. Α. Μπακόπουλος και Ι. Χρυσοβέργης, «Αριθμητικές Μέθοδοι Διαφορικών Εξισώσεων», Συμεών, 1986.
5. R. D. Cook, D. S. Malkus, M. E. Plesha, "Concepts and applications of finite element analysis", 3rd ed., New York; Chichester: Wiley, 1989.
6. K. J. Bathe, "Finite Element Procedures in Engineering Analysis", Prentice-Hall Inc., New Jersey, 1982.

7. T. R. J. Hughes, "The Finite Element Method – Linear Static & Dynamic Finite Element Analysis", Prentice-Hall ed., Englewood Cliffs, NJ, 1987.
8. J. N. Reddy, "An Introduction to the Finite Element Method", Second Edition, New York: McGraw - Hill, 1993.
9. G. H. Golub, C. F. Van Loan, "Matrix Computations", The Johns Hopkins University Press, 1989.
10. T. R. Chandrupatla, A. D. Belegundu, επιστ. επιμ. Χ. Φραγκάκης, «Εισαγωγή στα Πεπερασμένα Στοιχεία για Μηχανικούς», Κλειδάριθμος, 2006.

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Balopoulos Victor
Contact details:	vbalop@civil.duth.gr
Supervisors: (1)	YES
Evaluation methods: (2)	Written assignment (100%)
Implementation Instructions: (3)	Assignment submitted through e-class on set date.

(10) Please write YES or NO

(11) Note down the evaluation methods used by the teacher, e.g.

6. *written assignment* or/and exercises

7. written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(12) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.

NUMERICAL METHODS FOR THE SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

1. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
DEPARTMENT	CIVIL ENGINEERING/ MSc APPLIED MATHEMATICS		
LEVEL OF STUDIES	MSc - LEVEL 7		
COURSE CODE		SEMESTER	1 st SEMESTER
COURSE TITLE	NUMERICAL METHODS FOR THE SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS		
TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>		TEACHING HOURS PER WEEK	ECTS CREDITS
		3	7,5
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	Scientific area		
PREREQUISITES:	NO		
TEACHING & EXAMINATION LANGUAGE:	Greek		
COURSE OFFERED TO ERASMUS STUDENTS:	NO		
COURSE URL:	https://eclass.duth.gr/courses/TMB360/		

2. LEARNING OUTCOMES

Learning Outcomes <i>Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.</i>
<p>After completing the course, the participants will be able to:</p> <ul style="list-style-type: none"> • Approximate the solution of a first-order differential equation with single-step methods and with multiple-step methods • Solve numerical systems of differential equations • Solve higher order differential equations numerically • Understand the concepts of initial and boundary conditions problems

- Find the numerical solution of a problem according to some limitations and characteristics of a numerical method, such as accuracy, stability and computing time of its application
 - Check the accuracy of a numerical method, compare and choose the most appropriate numerical method
 - To solve 2nd order problems with Numerov's method
- By participating in the course lectures and carrying out the assignments, the postgraduate student applies the basic knowledge of the course to selected problems. At the end of the course the postgraduate student will be able to:
- 1) Choose the appropriate numerical method, check its convergence, accuracy and stability
 - 2) Apply the numerical method, optimize it and compare the results with other methods

General Skills	
<i>Name the desirable general skills upon successful completion of the module</i>	
<i>Search, analysis and synthesis of data and information,</i>	<i>Project design and management</i>
<i>ICT Use</i>	<i>Equity and Inclusion</i>
<i>Adaptation to new situations</i>	<i>Respect for the natural environment</i>
<i>Decision making</i>	<i>Sustainability</i>
<i>Autonomous work</i>	<i>Demonstration of social, professional and moral responsibility and sensitivity to gender issues</i>
<i>Teamwork</i>	<i>Critical thinking</i>
<i>Working in an international environment</i>	<i>Promoting free, creative and inductive reasoning</i>
<i>Working in an interdisciplinary environment</i>	
<i>Production of new research ideas</i>	

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Autonomous work.
- Production of free, creative and inductive thinking.
- Decision making.

3. COURSE CONTENT

- Initial Value Problems. Difference Equations.
- Single Step Methods. Runge-Kutta methods (Second order, Third order, Fourth order, Higher order). Calculation results. Convergence. Approximation of truncation errors). Elimination methods. Stability analysis. Implicit Runge-Kutta methods.
- Multistep Methods. Explicit multistep methods. (Adams, Bashforth, Nystrom, Types for $j=0,1,3,5$. Results of calculations with prediction methods). Implicit multistep methods. Multistep methods based on differentiation. General multi-step methods (determination of coefficients). Estimation of truncation error. Propagation Error Estimates). Prediction-Correction Methods.
- Numerical solution of systems of differential equations and differential equations of higher order.
- Convergence, stability of methods
- Numerov's method.

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD <i>Face to face, Distance learning, etc.</i>	Distance learning
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT)	Use of ICT technologies in Teaching and Communication with students

<i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i>													
<p>TEACHING ORGANIZATION</p> <p><i>The ways and methods of teaching are described in detail.</i></p> <p><i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i></p> <p><i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i></p>	<table border="1"> <thead> <tr> <th style="text-align: center;"><i>Activity</i></th> <th style="text-align: center;"><i>Workload/semester</i></th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td style="text-align: center;">39</td> </tr> <tr> <td>Research & Analysis</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Review studies</td> <td style="text-align: center;">108</td> </tr> <tr> <td>Examinations</td> <td style="text-align: center;">3</td> </tr> <tr> <td>Total</td> <td style="text-align: center;">150</td> </tr> </tbody> </table>	<i>Activity</i>	<i>Workload/semester</i>	Lectures	39	Research & Analysis	0	Review studies	108	Examinations	3	Total	150
	<i>Activity</i>	<i>Workload/semester</i>											
	Lectures	39											
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	Examinations	3											
Total	150												
<p>STUDENT EVALUATION</p> <p><i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</i></p> <p><i>Please indicate all relevant information about the course assessment and how students are informed</i></p>													
Examinations													

5. SUGGESTED BIBLIOGRAPHY

- Γ. Δ. Ακρίβης και Β. Α. Δουγαλής, Αριθμητικές Μέθοδοι για Συνήθεις Διαφορικές Εξισώσεις, Πανεπιστημιακές Εκδόσεις Κρήτης, 2006
- U. M. Ascher and L. R. Petzold, Computer Methods for Ordinary Differential Equations and Differential-Algebraic Equations, SIAM, Philadelphia, 1998.
- L. F. Shampine, Numerical Solution of Ordinary Differential Equations, Chapman and Hall, New York, 1994.

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Avrilia Konguetsof
Contact details:	akogkets@civil.duth.gr
Supervisors: (1)	NO
Evaluation methods: (2)	Written examination by distance learning methods
Implementation Instructions: (3)	<ul style="list-style-type: none"> • Failure to enter or entry at an unscheduled time will result in the student being disqualified from the exam. • Throughout the exam, examinees are connected to MS Teams and should have an open microphone so that there is uninterrupted audio contact between the examinee and the examiner. At the same time, they should immediately activate their microphone and camera in case they are asked for identification. • Required technological equipment: Ability to connect to the internet, use a camera, speakers, microphone, ability to scan/photograph the manuscript and create a pdf or compressed file in case of more than one page of response to a topic. • For the written exam, the examinees: (1) they will read the topics that will be posted in the eclass in the “Tasks” of the course one by one, (2) they will write their answer in Ms-Word (3) they will create a pdf or compressed zip/rar file and (4) they will upload it to eClass – Assignments - Submit Assignment, in a predetermined time (for each topic will be given a time proportional to its difficulty and extent) CAUTION! The file must be readable, otherwise they cannot be corrected and will be rejected. • Within the framework of actions for the protection of personal data, it is prohibited to record the examination process in any way, as well as to record or publish or post on websites or share with third parties or transmit or distribute in any way all or part of the distance examination. Also, it is the students' responsibility to protect their personal data by showing only what is required on camera. • Non-compliance of examinees with the rules of the examination and a finding of fraud on their part will result in the application of the plagiarism provisions. In the case of inability to participate in a remote assessment, the decision of the Rector's Council of the IFT will be made.

(13) Please write YES or NO

(14) Note down the evaluation methods used by the teacher, e.g.

6. *written assignment* or/and exercises

7. written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(15) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.

TEACHING OF MATHEMATICS

1. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
DEPARTMENT	CIVIL ENGINEERING		
LEVEL OF STUDIES	POST-GRADUATE, LEVEL 7		
COURSE CODE		SEMESTER	1 st SEMESTER
COURSE TITLE	TEACHING OF MATHEMATICS		
TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>		TEACHING HOURS PER WEEK	ECTS CREDITS
		3	7,5
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	General Knowledge		
PREREQUISITES:	None		
TEACHING & EXAMINATION LANGUAGE:	Greek		
COURSE OFFERED TO ERASMUS STUDENTS:	No		
COURSE URL:	https://eclass.duth.gr/courses/1031588/		

2. LEARNING OUTCOMES

Learning Outcomes

Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.

After the successful completion of this course, the post-graduate students will be able:

- To learn the principles of education
- To understand the problems of the teaching of Mathematics
- To study contemporary methods of the teaching of Mathematics
- To apply these methods via presentations of virtual courses
- To study teaching methods in Analysis, Algebra and Number Theory
- To study teaching methods for bridging the gap between secondary education and postgraduate studies.

General Skills

Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information, Project design and management

ICT Use

Equity and Inclusion

Adaptation to new situations

Respect for the natural environment

Decision making

Sustainability

Autonomous work

Demonstration of social, professional and moral responsibility and sensitivity to gender issues

Teamwork

Critical thinking

Working in an international environment

Promoting free, creative and inductive reasoning

Working in an interdisciplinary environment

Production of new research ideas

- Search, analysis and synthesis of data and information, ICT Use.
- Adaptation to new situations.
- Decision making.
- Autonomous work.

3. COURSE CONTENT

PART A: Basic teaching principles. Principle of supervision. Principle of self-reliance. Principle of individuality. Principle of topicality. Principle of sociability. Principle of encouragement. Principle of interaction. Teaching models: teacher-centered model, student-centered model. Classifications of teaching objectives. The modernization of mathematics teaching. Aims and objectives of mathematics education. Presentations of virtual courses.

PART B: Applied teaching of Mathematics. Indicators and their necessity. Elements of mathematical logic and its necessity. Teaching Methods on Mathematical Analysis. Teaching Methods in Algebra. Teaching methods of number theory. Teaching methods for bridging the gap between secondary education and postgraduate studies.

4. LEARNING & TEACHING METHODS - EVALUATION

<p>TEACHING METHOD <i>Face to face, Distance learning, etc.</i></p>	<p>Live distance learning</p>
<p>USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT)</p>	<p>Use of ICT in teaching and in communication with the students</p>

<i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i>													
<p>TEACHING ORGANIZATION</p> <p><i>The ways and methods of teaching are described in detail.</i></p> <p><i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i></p> <p><i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i></p>	<table border="1"> <thead> <tr> <th><i>Activity</i></th> <th><i>Workload/semester</i></th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td>39</td> </tr> <tr> <td>Bibliographical research and study</td> <td>78</td> </tr> <tr> <td>Assignments during the course</td> <td>30</td> </tr> <tr> <td>Final written exam</td> <td>3</td> </tr> <tr> <td>Total</td> <td>150</td> </tr> </tbody> </table>	<i>Activity</i>	<i>Workload/semester</i>	Lectures	39	Bibliographical research and study	78	Assignments during the course	30	Final written exam	3	Total	150
	<i>Activity</i>	<i>Workload/semester</i>											
	Lectures	39											
	Bibliographical research and study	78											
	Assignments during the course	30											
	Final written exam	3											
Total	150												
<p>STUDENT EVALUATION</p> <p><i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</i></p> <p><i>Please indicate all relevant information about the course assessment and how students are informed</i></p>													
<p>Assignments during the course.</p> <p>Presentations of virtual courses.</p> <p>Final written exam.</p>													

5. SUGGESTED BIBLIOGRAPHY

<ol style="list-style-type: none"> 1. J. Bruner, <i>The Process of Education</i>, Harvard University Press, 1960. 2. R. M. Gagne, <i>The conditions of learning</i>, New York: Holt, Rinehart & Wilson 1970 3. Γ. Φιλίππου - Κ. Χρίστου, <i>Διδακτική των Μαθηματικών</i>, Εκδόσεις Γ. Δαρδανος, Αθήνα 2004. 4. Αθ. Γαγάτσης, <i>Διδακτική των Μαθηματικών, Θεωρία – Έρευνα</i>, Εκδόσεις Art of Text A.E., Θεσσαλονίκη. 5. Αθ. Γαγάτσης, <i>Θέματα Διδακτικής των Μαθηματικών</i>, Εκδόσεις Κυριακίδη, Θεσσαλονίκη, 1993. 6. Θ. Γ. Εξαρχάκος, <i>Διδακτική των Μαθηματικών</i>, Εκδόσεις Ελληνικά Γράμματα, Γ Έκδοση.
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ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Prof. Christos Schinas Prof. Vasilis Papadopoulos
Contact details:	Email: cschinas@ee.duth.gr , Telephone: +30 25410 79763 Email: papadob@civil.duth.gr , Telephone: +30 25410 79747
Supervisors: (1)	No
Evaluation methods: (2)	Students are evaluated via written assignments during the course and a written final assignment.
Implementation Instructions: (3)	The course is given via live distance learning and emergency situations will not affect lectures and student evaluation.

(16) Please write YES or NO

(17) Note down the evaluation methods used by the teacher, e.g.

6. *written assignment* or/and exercises
7. written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(18) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.

FUZZY LOGIC AND APPLICATIONS

1. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
DEPARTMENT	CIVIL ENGINEERING		
LEVEL OF STUDIES	POST-GRADUATE, LEVEL 7		
COURSE CODE		SEMESTER	2 nd SEMESTER
COURSE TITLE	FUZZY LOGIC AND APPLICATIONS		
TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>		TEACHING HOURS PER WEEK	ECTS CREDITS
		3	7,5
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	Scientific Area		
PREREQUISITES:	None		
TEACHING & EXAMINATION LANGUAGE:	Greek		
COURSE OFFERED TO ERASMUS STUDENTS:	No		
COURSE URL:	https://eclass.duth.gr/courses/ENG129/		

2. LEARNING OUTCOMES

Learning Outcomes
<i>Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.</i>
<p><u>Learning Outcomes of the course Fuzzy Logic and Applications</u> Upon successful completion of the course, students:</p> <ul style="list-style-type: none"> • 1. They will have understood and be able to explain the difference between the concept of fuzzy set and classical set. They will be able to understand that the fuzzy set, is a natural evolution of the classical set. • 2. They will have acquired a satisfactory level of knowledge of the fundamental principles and models of fuzzy logic. • 3. They will have an understanding of the concept of a fuzzy relation. They will also have understood that the cornerstone of modern sciences, such as robotics and technical intelligence, is the "fuzzy entailment", which is a fuzzy relation. • 4. They will be able to distinguish when and why we apply intelligent techniques to a specific system, such as a social system, engineering system, etc.

General Skills	
<i>Name the desirable general skills upon successful completion of the module</i>	
<i>Search, analysis and synthesis of data and information,</i>	<i>Project design and management</i>
<i>ICT Use</i>	<i>Equity and Inclusion</i>
<i>Adaptation to new situations</i>	<i>Respect for the natural environment</i>
<i>Decision making</i>	<i>Sustainability</i>
<i>Autonomous work</i>	<i>Demonstration of social, professional and moral responsibility and sensitivity to gender issues</i>
<i>Teamwork</i>	<i>Critical thinking</i>
<i>Working in an international environment</i>	<i>Promoting free, creative and inductive reasoning</i>
<i>Working in an interdisciplinary environment</i>	
<i>Production of new research ideas</i>	

Search, analysis and synthesis of data and information, ICT Use.
Adaptation to new situations.
Decision making.
Autonomous work.

3. COURSE CONTENT

1. From classical logic to fuzzy logic
2. Operations between classical and fuzzy sets
3. Properties of fuzzy sets
4. a-intercepts of a fuzzy set
5. The negation (n) in fuzzy logic
6. De Morgan triad
7. Classical and fuzzy entailment
8. Degree of truth of fuzzy inference
9. Equivalence classes
10. Boolean matrix and relations
11. Fuzzy Linear Regression

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD <i>Face to face, Distance learning, etc.</i>	Live distance learning	
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) <i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i>	Use of ICT in teaching and in communication with the students	
TEACHING ORGANIZATION	Activity	Workload/semester
	Lectures	39

<p><i>The ways and methods of teaching are described in detail.</i></p> <p><i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i></p> <p><i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i></p>	Bibliographical research and study	78
	Assignments during the course	30
	Final written exam	3
	Total	150
<p>STUDENT EVALUATION</p> <p><i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</i></p> <p><i>Please indicate all relevant information about the course assessment and how students are informed</i></p>	<p>Assignments during the course.</p> <p>Final written exam.</p>	

5. SUGGESTED BIBLIOGRAPHY

1. Τζιμόπουλος Χ., Παπαδόπουλος Β., (2013), «Ασαφής λογική με εφαρμογές στις επιστήμες του μηχανικού», Εκδόσεις ΖΗΤΗ, Θεσσαλονίκη.
2. Timothy J. Ross, (2010), «Fuzzy Logic with Engineering Applications», Third edition, Wiley.
3. Μποτζώρης Γ., Παπαδόπουλος Β., (2015), «Ασαφή σύνολα Εφαρμογές στο σχεδιασμό και την διαχείριση έργων μηχανικού», Εκδόσεις σοφία Α.Ε.

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Emeritus Prof. Basil Papadopoulos
Contact details:	Email: papadob@civil.duth.gr
Supervisors: (1)	No
Evaluation methods: (2)	Students are evaluated via written assignments during the course and a written final assignment.
Implementation Instructions: (3)	The course is given via live distance learning and emergency situations will not affect lectures and student evaluation.

(19) Please write YES or NO

(20) Note down the evaluation methods used by the teacher, e.g.

6. *written assignment* or/and exercises
7. written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(21) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.

SPECIAL TOPICS IN LINEAR ALGEBRA

1. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
DEPARTMENT	CIVIL ENGINEERING		
LEVEL OF STUDIES	POST-GRADUATE, LEVEL 7		
COURSE CODE		SEMESTER	2 nd SEMESTER
COURSE TITLE	SPECIAL TOPICS IN LINEAR ALGEBRA		
TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>		TEACHING HOURS PER WEEK	ECTS CREDITS
		3	7,5
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	Scientific Area		
PREREQUISITES:	None		
TEACHING & EXAMINATION LANGUAGE:	Greek		
COURSE OFFERED TO ERASMUS STUDENTS:	No		
COURSE URL:	https://eclass.duth.gr/courses/TMB292/		

2. LEARNING OUTCOMES

Learning Outcomes <i>Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.</i>
<p>After the successful completion of this course, the post-graduate students will be able:</p> <ul style="list-style-type: none"> • To apply methods like “separation of variables” • To solve partial differential equations • To solve boundary-initial value problems • To study the asymptotic behavior of the solutions of difference equations • To study the boundedness, convergence and the stability of difference equations
General Skills <i>Name the desirable general skills upon successful completion of the module</i> <i>Search, analysis and synthesis of data and information, Project design and management</i>

<i>ICT Use</i>	<i>Equity and Inclusion</i>
<i>Adaptation to new situations</i>	<i>Respect for the natural environment</i>
<i>Decision making</i>	<i>Sustainability</i>
<i>Autonomous work</i>	<i>Demonstration of social, professional and moral responsibility and sensitivity to gender issues</i>
<i>Teamwork</i>	<i>Critical thinking</i>
<i>Working in an international environment</i>	<i>Promoting free, creative and inductive reasoning</i>
<i>Working in an interdisciplinary environment</i>	
<i>Production of new research ideas</i>	

- Search, analysis and synthesis of data and information, ICT Use.
- Adaptation to new situations.
- Decision making.
- Autonomous work.

3. COURSE CONTENT

Linear spaces. Inner products. Inner product spaces. Orthogonal projection. Gram-Smidt orthonormalization. Linear operators. Adjoint operators. Operators in inner product spaces. Orthonormal operators. Isomorphisms. Normal operators. Transformation of symmetric matrices to diagonal form. Basic theorems and applications. N-th root of a matrix. Diagonalization of matrices with multiplicity k . Computation of the power of a matrix. Application of the theory of 2X2 matrices to the stability of difference equations and to the linearization of difference equations. Jordan canonical form.

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD <i>Face to face, Distance learning, etc.</i>	Live distance learning												
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) <i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i>	Use of ICT in teaching and in communication with the students												
TEACHING ORGANIZATION <i>The ways and methods of teaching are described in detail.</i> <i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i> <i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i>	<table border="1"> <thead> <tr> <th style="text-align: center;"><i>Activity</i></th> <th style="text-align: center;"><i>Workload/semester</i></th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td style="text-align: center;">39</td> </tr> <tr> <td>Bibliographical research and study</td> <td style="text-align: center;">78</td> </tr> <tr> <td>Assignments during the course</td> <td style="text-align: center;">30</td> </tr> <tr> <td>Final written exam</td> <td style="text-align: center;">3</td> </tr> <tr> <td>Total</td> <td style="text-align: center;">150</td> </tr> </tbody> </table>	<i>Activity</i>	<i>Workload/semester</i>	Lectures	39	Bibliographical research and study	78	Assignments during the course	30	Final written exam	3	Total	150
<i>Activity</i>	<i>Workload/semester</i>												
Lectures	39												
Bibliographical research and study	78												
Assignments during the course	30												
Final written exam	3												
Total	150												
STUDENT EVALUATION <i>Description of the evaluation process</i> <i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development</i>	Assignments during the course. Final written exam.												

Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others

Please indicate all relevant information about the course assessment and how students are informed

5. SUGGESTED BIBLIOGRAPHY

1. K. Hoffman, R. Kunze, *Linear Algebra*, Prentice-Hall Inc., New Jersey 1971.
2. R. Bellman, *Introduction to Matrix Analysis*, McGraw-Hill Book Company, New York 1970.
3. B. Noble, J. W. Daniel, *Applied Linear Algebra*, Prentice-Hall Inc, New Jersey 1977.
4. R. A. Horn, C. R. Johnson, *Matrix Analysis*, Cambridge University Press, New York 1991.

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Prof. Christos Schinas Prof. Garyfalos Papaschinopoulos
Contact details:	Email: cschinas@ee.duth.gr , Telephone: +30 25410 79763 Email: gpapas@env.duth.gr , Telephone: +30 25410 79758
Supervisors: (1)	No
Evaluation methods: (2)	Students are evaluated via written assignments during the course and a written final assignment.
Implementation Instructions: (3)	The course is given via live distance learning and emergency situations will not affect lectures and student evaluation.

(22) Please write YES or NO

(23) Note down the evaluation methods used by the teacher, e.g.

6. *written assignment* or/and exercises
7. written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(24) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.

APPLIED ECONOMICS WITH A FOCUS ON THE ENVIRONMENT – ESG

1. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
DEPARTMENT	CIVIL ENGINEERING/ MSc APPLIED MATHEMATICS		
LEVEL OF STUDIES	MSc - LEVEL 7		
COURSE CODE		SEMESTER	2 nd SEMESTER
COURSE TITLE	APPLIED ECONOMICS WITH A FOCUS ON THE ENVIRONMENT – ESG		
TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>		TEACHING HOURS PER WEEK	ECTS CREDITS
		3	7,5
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	Background		
PREREQUISITES:	NO		
TEACHING & EXAMINATION LANGUAGE:	Greek		
COURSE OFFERED TO ERASMUS STUDENTS:	NO		
COURSE URL:			

2. LEARNING OUTCOMES

Learning Outcomes <i>Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.</i>
After the successful completion of the course, the postgraduate student will have: understood the importance of the basic concepts of economic science, the functioning mechanisms of the economy and society, the way the economy is interconnected with environmental systems, will have familiarized himself with the concepts of microeconomic environment and the ways of operating businesses, will have acquired the ability to apply environmental business management techniques, and analyze business environmental information. He will also have acquired the ability to write environmental management

programs and the ability to conduct economic analyzes of environmental business management.

General Skills	
<i>Name the desirable general skills upon successful completion of the module</i>	
<i>Search, analysis and synthesis of data and information,</i>	<i>Project design and management</i>
<i>ICT Use</i>	<i>Equity and Inclusion</i>
<i>Adaptation to new situations</i>	<i>Respect for the natural environment</i>
<i>Decision making</i>	<i>Sustainability</i>
<i>Autonomous work</i>	<i>Demonstration of social, professional and moral responsibility and sensitivity to gender issues</i>
<i>Teamwork</i>	<i>Critical thinking</i>
<i>Working in an international environment</i>	<i>Promoting free, creative and inductive reasoning</i>
<i>Working in an interdisciplinary environment</i>	
<i>Production of new research ideas</i>	

- Generation of new research ideas
- Adaptation to new situations
- Decision making
- Search, analysis and synthesis of data and information, using and technologies
- Respect for diversity and multiculturalism
- Respect for the natural environment
- Demonstrate social, professional and ethical responsibility and sensitivity to gender issues
- Promotion of free, creative and inductive thinking

3. COURSE CONTENT

Introduction to economics, consumer theory analysis, cost theory analysis of firms, product theory analysis of firms, production function analysis, consumption, saving and public expenditure function analysis, two-sector mathematical model analysis, three-sector mathematical model analysis, environmental performance theories of firms , techniques for applying environmental performance techniques for businesses, techniques for measuring the environmental performance of businesses, techniques for disclosing business environmental performance information and business collaboration techniques in environmental management and ESG information, GRI standards, SASBs and Integrative Reporting.

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD <i>Face to face, Distance learning, etc.</i>	Distance learning
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) <i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i>	Use of ICT technologies in Teaching and Communication with students

TEACHING ORGANIZATION	Activity	Workload/semester
<p>The ways and methods of teaching are described in detail.</p> <p>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</p> <p>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</p>	Lectures	39
	Research & Analysis	0
	Review studies	108
	Examinations	3
	Total	150
<p>STUDENT EVALUATION</p> <p>Description of the evaluation process</p> <p>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</p> <p>Please indicate all relevant information about the course assessment and how students are informed</p>	Examinations	

5. SUGGESTED BIBLIOGRAPHY

Nικολάου Ε.Ι., 2008. Περιβαλλοντική – Αειφόρος Λογιστική, Εκδόσεις Γκιούρδας.

Νικολάου Ε.Ι., Ευαγγελινός Η.Κ. και Σοφούλης Μ.Κ., 2020. Το Πλαίσιο για την Κοινωνικά Υπεύθυνη, Ηθική και Πράσινη Οικονομία Εκδόσεις Gutenberg, Αθήνα.

Νικολάου Ε.Ι. και Ευαγγελινός Η.Κ., Λογιστική Αειφόρου Επίδοσης Επιχειρήσεων, Εκδόσεις Δισιγμα, Θεσσαλονίκη.

Tsalis T., Grigoroudis E., Tsagarakis K. and Nikolaou E.I., 2015. A Dynamic Sustainability Balanced Scorecard methodology as a navigator for exploring the dynamics and complexity of corporate sustainability strategy, *Civil Engineering and Environmental Systems*, 32 (4), 281-300.

Nikolaou E.I., Evangelinos K. and Filho L., 2015. A System Dynamic approach for Exploring the Effects of Climate Change Risks on Firms' Economic Performance, *Journal of Cleaner Production*, 103, 499-506.

Nikolaou I.E. and Tsalis, T. (2018). A framework to evaluate eco-and social-labels for designing a sustainability consumption label to measure strong sustainability impact of firms/products. *Journal of Cleaner Production*, 182, 105-113.

Chatzitheodorou, K., Skouloudis, A., Evangelinos, K., & Nikolaou, I. (2019). Exploring socially responsible investment perspectives: A literature mapping and an investor classification. *Sustainable production and consumption*, 19, 117-129.

Nikolaou, I. E., Tsalis, T. A., & Evangelinos, K. I. (2019). A framework to measure corporate sustainability performance: A strong sustainability-based view of firm. *Sustainable Production and Consumption*, 18, 1-18.

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Ioannis Nikolaou
Contact details:	inikol@env.duth.gr
Supervisors: (1)	NO
Evaluation methods: (2)	Written examination by distance learning methods
Implementation Instructions: (3)	<ul style="list-style-type: none"> • Failure to enter or entry at an unscheduled time will result in the student being disqualified from the exam. • Throughout the exam, examinees are connected to MS Teams and should have an open microphone so that there is uninterrupted audio contact between the examinee and the examiner. At the same time, they should immediately activate their microphone and camera in case they are asked for identification. • Required technological equipment: Ability to connect to the internet, use a camera, speakers, microphone, ability to scan/photograph the manuscript and create a pdf or compressed file in case of more than one page of response to a topic. • For the written exam, the examinees: (1) they will read the topics that will be posted in the eclass in the “Tasks” of the course one by one, (2) they will write their answer in Ms-Word (3) they will create a pdf or compressed zip/rar file and (4) they will upload it to eClass – Assignments - Submit Assignment, in a predetermined time (for each topic will be given a time proportional to its difficulty and extent) CAUTION! The file must be readable, otherwise they cannot be corrected and will be rejected. • Within the framework of actions for the protection of personal data, it is prohibited to record the examination process in any way, as well as to record or publish or post on websites or share with third parties or transmit or distribute in any way all or part of the distance examination. Also, it is the students' responsibility to protect their personal data by showing only what is required on camera. • Non-compliance of examinees with the rules of the examination and a finding of fraud on their part will result in the application of the plagiarism provisions. In the case of inability to participate in a remote assessment, the decision of the Rector's Council of the IFT will be made.

(25) Please write YES or NO

(26) Note down the evaluation methods used by the teacher, e.g.

6. *written assignment* or/and exercises

7. written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(27) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.

STOCHASTIC ANALYSIS OF TIME SERIES

1. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
DEPARTMENT	CIVIL ENGINEERING/ MSc APPLIED MATHEMATICS		
LEVEL OF STUDIES	MSc - LEVEL 7		
COURSE CODE		SEMESTER	2 nd SEMESTER
COURSE TITLE	STOCHASTIC ANALYSIS OF TIME SERIES		
TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>	TEACHING HOURS PER WEEK	ECTS CREDITS	
	3	7,5	
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	Scientific area		
PREREQUISITES:	NO		
TEACHING & EXAMINATION LANGUAGE:	Greek		
COURSE OFFERED TO ERASMUS STUDENTS:	NO		
COURSE URL:	https://eclass.duth.gr/courses/1021375		

2. LEARNING OUTCOMES

Learning Outcomes
Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.

After completing the course, postgraduate students will be able to:

- Use stochastic time series models and the method of least squares.
- Estimate Parameters with different methods.
- Determining the appropriate model.
- Calculate of residuals and estimation of their autocorrelation coefficient.
- Calculate of the likelihood function of correlated observations.
- To use Iterative Kalman filter and prediction equations and their applications Applications.
- Kalman filter smoothing equations. Predictions and applications.
- Non-Gaussian and nonlinear state-space models. Bayesian models and their applications.
- The Monte Carlo Markov Chain method.

General Skills

Name the desirable general skills upon successful completion of the module

<i>Search, analysis and synthesis of data and information,</i>	<i>Project design and management</i>
<i>ICT Use</i>	<i>Equity and Inclusion</i>
<i>Adaptation to new situations</i>	<i>Respect for the natural environment</i>
<i>Decision making</i>	<i>Sustainability</i>
<i>Autonomous work</i>	<i>Demonstration of social, professional and moral responsibility and sensitivity to gender issues</i>
<i>Teamwork</i>	<i>Critical thinking</i>
<i>Working in an international environment</i>	<i>Promoting free, creative and inductive reasoning</i>
<i>Working in an interdisciplinary environment</i>	
<i>Production of new research ideas</i>	

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Autonomous work.
- Production of free, creative and inductive thinking.
- Decision making.

3. COURSE CONTENT

Stochastic time series models. Parameter estimation using the method of least squares. Parameter estimation by maximizing the likelihood function. Short term forecasts. Examples. Determining the appropriate model. Health check. Calculation of residuals and estimation of their autocorrelation coefficient. The general state-space model. Stochastic time series models that are special cases of the general state-space model. Calculation of the likelihood function of correlated observations. Kalman filter. Iterative Kalman filter equations. Kalman filter prediction equations. Renewal equations of the Kalman filter. Applications. Steady state of state-space models. Selection of initial values. Kalman filter smoothing equations. Predictions and applications in noisy random walk and non-local linear stress models. Non-Gaussian and nonlinear state-space models. Bayesian models and their applications. The Monte Carlo Markov Chain method.

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD <i>Face to face, Distance learning, etc.</i>	Distance learning
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<p align="center">USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT)</p> <p align="center"><i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i></p>	<p>Use of ICT technologies in Teaching and Communication with students</p>													
<p align="center">TEACHING ORGANIZATION</p> <p><i>The ways and methods of teaching are described in detail.</i></p> <p><i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i></p> <p><i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i></p>	<table border="1"> <thead> <tr> <th align="center"><i>Activity</i></th> <th align="center"><i>Workload/semester</i></th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td align="center">39</td> </tr> <tr> <td>Research & Analysis</td> <td align="center">0</td> </tr> <tr> <td>Review studies</td> <td align="center">108</td> </tr> <tr> <td>Examinations</td> <td align="center">3</td> </tr> <tr> <td>Total</td> <td align="center">150</td> </tr> </tbody> </table>		<i>Activity</i>	<i>Workload/semester</i>	Lectures	39	Research & Analysis	0	Review studies	108	Examinations	3	Total	150
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Total	150													
<p align="center">STUDENT EVALUATION</p> <p><i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</i></p> <p><i>Please indicate all relevant information about the course assessment and how students are informed</i></p>	<p>Examinations</p>													

5. SUGGESTED BIBLIOGRAPHY

1. G. Kitagawa "Introduction to Time Series Modeling", Chapman&Hall/CRC, London, 2010.
2. G. Janacek, "Practical Time Series", Arnold, London, 2001.
3. J. Durbin and S.J. Koopans, "Time Series Analysis by State Space Models", 2nd Edition, Oxford University Press, Oxford, 2012.
4. A.C Harvey, S.J. Koopman and N. Shephard (Eds), "State Space and Unobserved Component Models: Theory and Applications", Cambridge, Cambridge University Press, 2004.

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Alexandros Rigas
Contact details:	rigas@ee.duth.gr
Supervisors: (1)	NO
Evaluation methods: (2)	Written examination by distance learning methods
Implementation Instructions: (3)	<ul style="list-style-type: none"> • Failure to enter or entry at an unscheduled time will result in the student being disqualified from the exam. • Throughout the exam, examinees are connected to MS Teams and should have an open microphone so that there is uninterrupted audio contact between the examinee and the examiner. At the same time, they should immediately activate their microphone and camera in case they are asked for identification. • Required technological equipment: Ability to connect to the internet, use a camera, speakers, microphone, ability to scan/photograph the manuscript and create a pdf or compressed file in case of more than one page of response to a topic. • For the written exam, the examinees: (1) they will read the topics that will be posted in the eclass in the “Tasks” of the course one by one, (2) they will write their answer in Ms-Word (3) they will create a pdf or compressed zip/rar file and (4) they will upload it to eClass – Assignments - Submit Assignment, in a predetermined time (for each topic will be given a time proportional to its difficulty and extent) CAUTION! The file must be readable, otherwise they cannot be corrected and will be rejected. • Within the framework of actions for the protection of personal data, it is prohibited to record the examination process in any way, as well as to record or publish or post on websites or share with third parties or transmit or distribute in any way all or part of the distance examination. Also, it is the students' responsibility to protect their personal data by showing only what is required on camera. • Non-compliance of examinees with the rules of the examination and a finding of fraud on their part will result in the application of the plagiarism provisions. In the case of inability to participate in a remote assessment, the decision of the Rector's Council of the IFT will be made.

(28) Please write YES or NO

(29) Note down the evaluation methods used by the teacher, e.g.

6. *written assignment* or/and exercises

7. written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(30) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.

INTELLIGENT MODELLING – HYBRID SOFT COMPUTING INFORMATION SYSTEMS

1. GENERAL

SCHOOL	OF ENGINEERING		
DEPARTMENT	CIVIL ENGINEERING/ MSc APPLIED MATHEMATICS		
LEVEL OF STUDIES	MSc - LEVEL 7		
COURSE CODE		SEMESTER	2 nd Semester
COURSE TITLE	INTELLIGENT MODELLING – HYBRID SOFT COMPUTING INFORMATION SYSTEMS		
TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>		TEACHING HOURS PER WEEK	ECTS CREDITS
		3	7,5
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	Scientific area		
PREREQUISITES:	NO		
TEACHING & EXAMINATION LANGUAGE:	Greek		
COURSE OFFERED TO ERASMUS STUDENTS:	NO		
COURSE URL:	https://eclass.duth.gr/courses/TMB360/		

2. LEARNING OUTCOMES

Learning Outcomes	
<i>Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.</i>	
<p>After completing the course, the participants will be able to:</p> <p>The purpose of the course is to introduce and deepen the graduate students in the following Areas of Machine Learning and Computational Intelligence:</p> <ul style="list-style-type: none"> - Data Science (Data Preprocessing) - Knowledge Mining - Supervised Machine Learning - Unsupervised Machine Learning (FCMC Fuzzy c-means Clustering – SOM Self Organizing Maps) - Machine Learning Algorithms (Description and Analysis) - Soft Computing Modeling Applications (Fuzzy Logic modeling -Artificial Neural Networks – Support Vector Machines) - Deep Learning (Convolutional Neural Networks – Recurrent NN) - Case studies: Models’ Development using real (raw) data 	
General Skills	
<i>Name the desirable general skills upon successful completion of the module</i>	
<i>Search, analysis and synthesis of data and information,</i>	<i>Project design and management</i>
<i>ICT Use</i>	<i>Equity and Inclusion</i>
<i>Adaptation to new situations</i>	<i>Respect for the natural environment</i>
<i>Decision making</i>	<i>Sustainability</i>
<i>Autonomous work</i>	<i>Demonstration of social, professional and moral responsibility and sensitivity to gender issues</i>
<i>Teamwork</i>	<i>Critical thinking</i>
<i>Working in an international environment</i>	<i>Promoting free, creative and inductive reasoning</i>
<i>Working in an interdisciplinary environment</i>	
<i>Production of new research ideas</i>	
<ul style="list-style-type: none"> – Search, analysis and synthesis of data and information, using the necessary technologies. – Adaptation in new cases – Decision Making – Autonomous work. – Interdisciplinary work – Production of free, creative and inductive thinking. 	

3. COURSE CONTENT

Data Science

Data preprocessing

Parameter correlation analysis

Detection – Removal of outliers

Identifying and solving the problem of Minority classes

Data Transformation

Production of classes

Machine Learning

Presentation of the Mathematical Model of Artificial Neural Networks. THE

Back Propagation algorithm Examples - case studies – problems solving

The Gradient Descent optimization algorithm

Learning

Avoiding Memorization – Overtraining

Developing Regression Patterns Using Machine Learning
 Classification and Use of Machine Learning algorithms
 Feed Forward Multilayer Artificial Neural Networks
 K-nearest neighbors
 Recurrent Neural Networks
 Fuzzy c-means clustering
 Deep Learning – Convolutional Neural Networks
 Examples of Machine Vision programs
 MNIST and Deep Learning Standards

4. LEARNING & TEACHING METHODS - EVALUATION

<p>TEACHING METHOD <i>Face to face, Distance learning, etc.</i></p>	Distance learning	
<p>USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) <i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i></p>	Use of ICT technologies in Teaching and Communication with students	
<p>TEACHING ORGANIZATION <i>The ways and methods of teaching are described in detail.</i></p> <p><i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i></p> <p><i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i></p>	Activity	Workload/semester
	Lectures (Theory)	39
	Research & Analysis	0
	Review studies	108
	Examinations	3
	Total	150
<p>STUDENT EVALUATION <i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</i></p> <p><i>Please indicate all relevant information about the course assessment and how students are informed</i></p>	<p>Examinations</p> <p>Assignments on Machine Learning modeling using real data or Written examination</p>	

5. SUGGESTED BIBLIOGRAPHY

A. Lazaros Iliadis, Antonis Papaleonidas, Computational Intelligence and Intelligent Agents 2016 Tziolas Publishing

B. Neural Networks and Learning Machines Simon Haykin, 3rd Edition, 2009, Prentice Hall

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Lazaros Iliadis
Contact details:	liliadis@civil.duth.gr
Supervisors: (1)	NO
Evaluation methods: (2)	I. Assignment of Machine Learning Modeling development on Real-Life Cases (datasets) /Or II. Written examination by distance learning methods
Implementation Instructions: (3)	• The students can chose either of the two above options. In the 1 st case they are assigned a Machine Learning Project based on Real-Life datasets. After developing the models the students have to submit their work /assignment and they have to defend to Prof Iliadis via Webex or Teachers.

(31) Please write YES or NO

(32) Note down the evaluation methods used by the teacher, e.g.

6. *written assignment* or/and exercises

7. written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(33) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.

NUMERICAL METHODS FOR THE SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS

1. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
DEPARTMENT	CIVIL ENGINEERING/ MSc APPLIED MATHEMATICS		
LEVEL OF STUDIES	MSc - LEVEL 7		
COURSE CODE		SEMESTER	2 nd SEMESTER
COURSE TITLE	NUMERICAL METHODS FOR THE SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS		
TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>	TEACHING HOURS PER WEEK	ECTS CREDITS	
	3	7,5	
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	Scientific area		
PREREQUISITES:	NO		
TEACHING & EXAMINATION LANGUAGE:	Greek		
COURSE OFFERED TO ERASMUS STUDENTS:	NO		
COURSE URL:	https://eclass.duth.gr/courses/TMB361/		

2. LEARNING OUTCOMES

Learning Outcomes
<i>Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.</i>
<p>After completing the course, postgraduate students will be able to:</p> <ul style="list-style-type: none"> • Identify the class of differential equation and the type of problem according to the initial and boundary conditions. • To approximate the solution of a 2nd order partial differential equation by choosing the appropriate method according to the data of the problem. • To adjust the number of computational operations by shaping the step within the area under investigation. • To find the numerical solution of a problem according to some limitations and characteristics of a numerical method, such as accuracy, stability and computing time of its application. • Construct and apply the methodology-algorithm for solving the initial-boundary value problem. • To check the convergence and stability of a numerical method.

General Skills	
<i>Name the desirable general skills upon successful completion of the module</i>	
<i>Search, analysis and synthesis of data and information,</i>	<i>Project design and management</i>
<i>ICT Use</i>	<i>Equity and Inclusion</i>
<i>Adaptation to new situations</i>	<i>Respect for the natural environment</i>
<i>Decision making</i>	<i>Sustainability</i>
<i>Autonomous work</i>	<i>Demonstration of social, professional and moral responsibility and sensitivity to gender issues</i>
<i>Teamwork</i>	<i>Critical thinking</i>
<i>Working in an international environment</i>	<i>Promoting free, creative and inductive reasoning</i>
<i>Working in an interdisciplinary environment</i>	
<i>Production of new research ideas</i>	
<ul style="list-style-type: none"> – Search, analysis and synthesis of data and information, using the necessary technologies. – Autonomous work. – Production of free, creative and inductive thinking. – Decision making. 	

3. COURSE CONTENT

Approximation of partial derivatives using Finite Differences. Classes of Partial Differential Equations and known problems. Initial and boundary condition problems. Direct and indirect methods. Numerical solution of Parabolic Equations, Elliptic Equations and Hyperbolic Equations. Convergence, stability.

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD <i>Face to face, Distance learning, etc.</i>	Distance learning	
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) <i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i>	Use of ICT technologies in Teaching and Communication with students	
TEACHING ORGANIZATION <i>The ways and methods of teaching are described in detail.</i> <i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i> <i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i>	Activity	Workload/semester
	Lectures	39
	Research & Analysis	0
	Review studies	108
	Examinations	3
	Total	150
STUDENT EVALUATION <i>Description of the evaluation process</i> <i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development</i>	Examinations	

Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others

Please indicate all relevant information about the course assessment and how students are informed

5. SUGGESTED BIBLIOGRAPHY

- Δουγαλής, Β. (2013). Finite element methods for the numerical solution of partial differential equations. Αθήνα. (Πανεπιστημιακές Σημειώσεις)
- Ciarlet, P. G. (2002). The finite element method for elliptic problems (Vol. 40). Society for Industrial and Applied Mathematics (SIAM), Philadelphia, PA
- “Αριθμητική επίλυση μερικών διαφορικών εξισώσεων”, Π. Χατζηπαντελίδης, & Μ. Πλεξουσάκης, Κάλλιπος, (2015).
- Partial differential equations with numerical methods, S. Larsson, & V. Thomée, Springer-Verlag, Berlin, 2009.

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Avrilia Konguetsof
Contact details:	akogkets@civil.duth.gr
Supervisors: (1)	NO
Evaluation methods: (2)	Written examination by distance learning methods
Implementation Instructions: (3)	<ul style="list-style-type: none"> • Failure to enter or entry at an unscheduled time will result in the student being disqualified from the exam. • Throughout the exam, examinees are connected to MS Teams and should have an open microphone so that there is uninterrupted audio contact between the examinee and the examiner. At the same time, they should immediately activate their microphone and camera in case they are asked for identification. • Required technological equipment: Ability to connect to the internet, use a camera, speakers, microphone, ability to scan/photograph the manuscript and create a pdf or compressed file in case of more than one page of response to a topic. • For the written exam, the examinees: (1) they will read the topics that will be posted in the eclass in the “Tasks” of the course one by one, (2) they will write their answer in Ms-Word (3) they will create a pdf or compressed zip/rar file and (4) they will upload it to eClass – Assignments - Submit Assignment, in a predetermined time (for each topic will be given a time proportional to its difficulty and extent) CAUTION! The file must be readable, otherwise they cannot be corrected and will be rejected. • Within the framework of actions for the protection of personal data, it is prohibited to record the examination process in any way, as well as to record or publish or post on websites or share with third parties or transmit or distribute in any way all or part of the distance examination. Also, it is the students' responsibility to protect their personal data by showing only what is required on camera. • Non-compliance of examinees with the rules of the examination and a finding of fraud on their part will result in the application of the plagiarism provisions. In the case of inability to participate in a remote assessment, the decision of the Rector's Council of the IFT will be made.

(34) Please write YES or NO

(35) Note down the evaluation methods used by the teacher, e.g.

6. *written assignment* or/and exercises

7. written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(36) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.

GRAPH THEORY

1. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
DEPARTMENT	CIVIL ENGINEERING/ MSc APPLIED MATHEMATICS		
LEVEL OF STUDIES	MSc - LEVEL 7		
COURSE CODE		SEMESTER	2 nd SEMESTER
COURSE TITLE	GRAPH THEORY		
TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>		TEACHING HOURS PER WEEK	ECTS CREDITS
		3	7,5
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	Scientific area		
PREREQUISITES:	NO		
TEACHING & EXAMINATION LANGUAGE:	Greek		
COURSE OFFERED TO ERASMUS STUDENTS:	NO		
COURSE URL:			

2. LEARNING OUTCOMES

Learning Outcomes	
Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.	
Upon successful completion of the course, participants will be able to: - Extend and deepen the graduate student's understanding of advanced topics in the application of Graph Theory to Industrial Production. - understand the aforementioned theory so that the graduate student can make use of Graph Theory to solve problems related to the production process (sequencing of tasks - minimizing total machine running time).	
General Skills	
Name the desirable general skills upon successful completion of the module	
Search, analysis and synthesis of data and information,	Project design and management
ICT Use	Equity and Inclusion
Adaptation to new situations	Respect for the natural environment
Decision making	Sustainability
Autonomous work	Demonstration of social, professional and moral responsibility and sensitivity to gender issues
Teamwork	Critical thinking
Working in an international environment	Promoting free, creative and inductive reasoning
Working in an interdisciplinary environment	
Production of new research ideas	
<ul style="list-style-type: none"> - Search, analysis and synthesis of data and information, using the necessary technologies. - Autonomous work. - Production of free, creative and inductive thinking. - Decision making. 	

3. COURSE CONTENT

Introduction to Graphs and Graph Theory (basic concepts and mathematical definitions). Graph isomorphisms. Representation of Graphs (adjacency matrix, incidence matrix, edge lists). Graph sequence and graph construction (Graph Sequence Algorithm). Operations with Graphs and properties (union - intersection - ring sum - convolution - complement - edge swap - sum of Graphs). Basic Graphs (complete Graph - complementary Graph - Signature - bilateral Graph). Directed Graphs. Coherence (Menger's Theorem). Permeability (paths - paths - circles - Hamilton's Theorem and Euler's Theorem). Trees (Arranged Trees - Binary Trees - Tree Crossing - Overlapping Trees). Representation of discrete structures in the real world with tree structures. Planar and Planar Graphs . Graph coloring. Applications of Graph Theory in Industrial Production.

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD <i>Face to face, Distance learning, etc.</i>	Distance learning	
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) <i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i>	Use of ICT technologies in Teaching and Communication with students	
TEACHING ORGANIZATION	Activity	Workload/semester
	Lectures	39

<p><i>The ways and methods of teaching are described in detail.</i></p> <p><i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i></p> <p><i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i></p>	Research & Analysis	0
	Review studies	108
	Examinations	3
	Total	150
<p>STUDENT EVALUATION</p> <p><i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</i></p> <p><i>Please indicate all relevant information about the course assessment and how students are informed</i></p>	Examinations	

5. SUGGESTED BIBLIOGRAPHY

1. Λ. Κυρούσης, Χ. Μπούρας, Π. Σπυράκης, Γ. Σταματίου. Εισαγωγή στους Γράφους. CTI Press, ISBN 960-01-0815-3, 1999.
2. Γιάννης Μανωλόπουλος, Μαθήματα Θεωρίας Γράφων: Θεμελιώσεις – Αλγόριθμοι – Εφαρμογές. Εκδόσεις Νέων Τεχνολογιών, ISBN 960-7235-87-8, Έκδοση 2η (2000).
3. Μάριος Μαυρονικόλας, Διακριτά Μαθηματικά και Μαθηματική λογική, τόμος Β, Θεωρία Γράφων , ISBN : 960 538-461-2 5. Reinhard Diestel, Graph Theory, Electronic Edition 2005, Springer- Verlag Heidelberg ,New York 1997,2000,2005.
4. Reinhard Diestel, Graph Theory, Electronic Edition 2005, Springer- Verlag Heidelberg, New York 1997,2000,2005.

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Stefanos Spartalis
Contact details:	sspart@pme.duth.gr
Supervisors: (1)	NO
Evaluation methods: (2)	Written examination by distance learning methods
Implementation Instructions: (3)	<ul style="list-style-type: none"> • Failure to enter or entry at an unscheduled time will result in the student being disqualified from the exam. • Throughout the exam, examinees are connected to MS Teams and should have an open microphone so that there is uninterrupted audio contact between the examinee and the examiner. At the same time, they should immediately activate their microphone and camera in case they are asked for identification. • Required technological equipment: Ability to connect to the internet, use a camera, speakers, microphone, ability to scan/photograph the manuscript and create a pdf or compressed file in case of more than one page of response to a topic. • For the written exam, the examinees: (1) they will read the topics that will be posted in the eclass in the “Tasks” of the course one by one, (2) they will write their answer in Ms-Word (3) they will create a pdf or compressed zip/rar file and (4) they will upload it to eClass – Assignments - Submit Assignment, in a predetermined time (for each topic will be given a time proportional to its difficulty and extent) CAUTION! The file must be readable, otherwise they cannot be corrected and will be rejected. • Within the framework of actions for the protection of personal data, it is prohibited to record the examination process in any way, as well as to record or publish or post on websites or share with third parties or transmit or distribute in any way all or part of the distance examination. Also, it is the students' responsibility to protect their personal data by showing only what is required on camera. • Non-compliance of examinees with the rules of the examination and a finding of fraud on their part will result in the application of the plagiarism provisions. In the case of inability to participate in a remote assessment, the decision of the Rector's Council of the IFT will be made.

(37) Please write YES or NO

(38) Note down the evaluation methods used by the teacher, e.g.

6. *written assignment* or/and exercises

7. written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(39) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.

MASTER'S THESIS

1. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
DEPARTMENT	CIVIL ENGINEERING		
LEVEL OF STUDIES	GRADUATE PROGRAM LEVEL 7		
COURSE CODE		SEMESTER	3 rd Semester
COURSE TITLE	Master's Thesis		
TEACHING ACTIVITIES <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>		TEACHING HOURS PER WEEK	ECTS CREDITS
		0	30
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	SCIENTIFIC AREA		
PREREQUISITES:	NONE		
TEACHING & EXAMINATION LANGUAGE:	GREEK - ENGLISH		
COURSE OFFERED TO ERASMUS STUDENTS:	NO		
COURSE URL:			

2. LEARNING OUTCOMES

Learning Outcomes
Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.

Upon successful completion of their thesis, participants will be in a position to:

- possess in-depth knowledge of the subject treated in it.
- perceive the material studied in the Program's courses as a coherent whole.
- look up and take in related scientific publications in Greek and English
- process and evaluate data and results
- develop, implement and assess mathematical/computational models for the analysis/design or forecasting or management of any system (natural or man-made, mechanical, financial, societal, etc.).

General Skills
Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information,	Project design and management
ICT Use	Equity and Inclusion
Adaptation to new situations	Respect for the natural environment
Decision making	Sustainability
Autonomous work	Demonstration of social, professional and moral responsibility and sensitivity to gender issues
Teamwork	Critical thinking
Working in an international environment	Promoting free, creative and inductive reasoning
Working in an interdisciplinary environment	
Production of new research ideas	

- Search, analysis and synthesis of data and information, with ICT use
- Working in an interdisciplinary environment
- Generating new research ideas
- Autonomous work
- Promoting free, creative and inductive reasoning
- Project design and management (with emphasis on mathematical models)

3. COURSE CONTENT

Graduate Thesis

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD <i>Face to face, Distance learning, etc.</i>	Collaboration with advisor	
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) <i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i>	Use of ICT in Teaching and Communication with the students	
TEACHING ORGANIZATION	<i>Activity</i>	<i>Workload/semester</i>

<p><i>The ways and methods of teaching are described in detail.</i></p> <p><i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i></p> <p><i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i></p>	Thesis development and writeup	200
	Thesis defense	50
	Literature study and review	200
	Course Total	450
<p>STUDENT EVALUATION</p> <p><i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</i></p> <p><i>Please indicate all relevant information about the course assessment and how students are informed</i></p>	<p>Submission and approval of Thesis book</p> <p>Oral presentation and defense of Thesis to three-member examination committee</p>	