UNIVERSITY OF IOANNINA
SCHOOL OF SCIENCES
DEPARTMENT OF MATHEMATICS

COURSES OUTLINE

UNDERGRADUATE STUDIES

TABLE OF CONTENTS

COURSE OUTLINE
MAY111 – INFINITESIMAL CALCULUS I

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY111**	**SEMESTER**	1st
COURSE TITLE	**Infinitesimal Calculus I**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		5	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Language of Instruction (lectures): Greek. Language of Instruction (activities other than lectures): Greek and English Language of Examinations: Greek and English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	Course description: http://math.uoi.gr (go to: Studies -> UnderGraduate Studies -> Courses) Learning Management System (e.g.: Moodle): http://users.uoi.gr/kmavridi (go to: Courses)		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Here, the acronym RFooV stands for Real Function of one Variable.
Learning outcomes according to Bloom Taxonomy:
Remembering:

1. Introduction to the sets of Natural Numbers, Integer Numbers, Rational Numbers, Irrational Numbers and Real Numbers, viewed from the aspect of Mathematical Analysis. Bounded and not bounded subsets of such sets.
2. Basic concepts of Trigonometry.

3. The concept of RFooV. Some basic properties of such functions. Elementary RFooVs.
4. The concept of real valued sequences. Study of such sequences, including existence and calculation of limits.
5. Limits and continuity of RFooV, using the (ε-δ) definition and the sequential definition. Basic properties of convergent RFooVs. Basic properties of continuous RFooVs. Classes of non-continuous RFooVs.
6. Derivative of RFooV using the (ε-δ) definition and the sequential definition. Derivatives of elementary RFooVs. Calculation of derivatives.

Comprehension:

1. Methods of establishing a mathematical concept based on axioms and based of construction.
2. Calculation and finding properties of sets of real numbers. Minimum upper and maximum lower boundaries.
3. Graphing RFooVs, monotone RFooVs, bounded RFooVs, periodic RFooVs.
4. Subsequences, the Bolzano-Weierstass Theorem, Cauchy sequences.
5. Local behaviour of continuous RFooVs. The Bolzano Theorem and the Intermediate Values Theorem. Properties of continuous RFooVs defined in closed intervals, continuity of reverse continuous RFooVs. Uniform continuity of RFooVs defined in closed intervals.
6. Methods of derivation, higher order derivatives. The Rolle Theorem, the Mean Value Theorem, the Darboux Theorem. The connection between derivative and monotonicity, extrema of RFooVs, convex and concave RFooVs, inflections points. Theorems for the derivation of inverse RFooVs. Generalized Mean Value Theorem, the De L' Hospital Rule. Studying RFooVs using derivatives.

Applying:

1. Existence and uniqueness of solutions of non-linear equations.
2. Finding maximum and minimum values of quantities, which emerge in problems in Natural Sciences.
3. Plotting RFooVs.

Evaluating: Teaching undergraduate courses.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Creative, analytical and inductive thinking.
- Required for the creation of new scientific ideas.
- Working independently.
- Working in groups.
- Decision making.

SYLLABUS

Real numbers, axiomatic foundation of the set of real numbers (emphasis in the notion of supremum and infimim), natural numbers, induction, classical inequalities.
Functions, graph of a function, monotone functions, bounded functions, periodic functions. Injective and surjective functions, inverse of a function. Trigonometric functions, inverse trigonometric functions, exponential and logarithmic functions, hyperbolic and inverse hyperbolic functions.
Sequences of real numbers, convergent sequences, monotone sequences, sequences defined by recursion, limits of monotone sequences, nested intervals. The notion of subsequence, Bolzano Weierstass' Theorem, Cauchy sequences. Accumulation points of sequences, upper and lower limit of a sequence (limsup, liminf).
Continuity of functions, accumulation points and isolated points, limits of functions, one sided limits, limits on plus infinity and minus infinity. Continuity of several basic functions, local behaviour of a continuous function. Bolzano Theorem and intermediate value theorem. Characterization of continuity via sequences, properties of continuous functions defined on closed intervals, continuity of inverse functions.
Derivative of a function, definition and geometric interpretation, examples and applications in sciences. The derivatives of elementary functions, derivation rules, higher order derivation. Rolle's Theorem, Mean Value Theorem, Darboux's theorem. Derivative and the monotonicity of a function, extrema of functions, convex and concave functions, inflection points. Derivation of inverse functions. Generalized Mean Value Theorem, De L' Hospital rule. Study of functions using derivatives.

TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>
Lectures in class.
Learning Management System (e.g.: Moodle).</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>
Use of Learning Management System (e.g.: Moodle), combined with File Sharing and Communication Platform (e.g.: NextCloud) for
distributing teaching material,
submission of assignments,
course announcements,
gradebook keeping for all students evaluation procedures,
communicating with students.
Use of Web Appointment Scheduling System (e.g.: Easy!Appointments) for organising office appointments.
Use of Google services for submitting anonymous evaluations regarding the teacher.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>65</td></tr>
<tr><td>Study and analysis of bibliography</td><td>100</td></tr>
<tr><td>Preparation of assignments and interactive teaching</td><td>22.5</td></tr>
<tr><td>Course total</td><td>187.5</td></tr>
</table></td></tr>
</table>

writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Language of evaluation: Greek and English. Methods of evaluation: 1. Weekly written assignments. 2. Few number of tests during the semester. 3. Based on their grades in the aforementioned weekly assignments and tests, limited number of students can participate in exams towards the end of the semester, before the beginning of the exams period. 4. In any case, all students can participate in written exams at the end of the semester, during the exams period. The aforementioned information along with all the required details are available through the course's website. The information is explained in detail at the beginning of the semester, as well as, throughout the semester, during the lectures. Reminders are also posted at the beginning of the semester and throughout the semester, through the course's website. Upon request, all the information is provided using email or social networks.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:(see Eudoxus)
- Related academic journals: (see Eudoxus)

COURSE OUTLINE
MAY112 – FUNDAMENTAL CONCEPTS OF MATHEMATICS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY112**	**SEMESTER**	1st
COURSE TITLE	**Fundamental Concepts of Mathematics**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		5	7,5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://www.math.uoi.gr/GR/studies/undergraduate/courses/may112.html		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
As a first step, the students get familiar with basic tools of logic, set theory (set operations and properties), relations and functions. Emphasis is given to notions such as collections and families (coverings) bounds (max, min, sup, inf) as well as to images and pre-images of sets under functions. Part of the kernel of the course is a detailed axiomatic construction of the real numbers aiming that the students acknowledge this set as result of an axiomatic construction rather than of an empiric approach, yet the value and the significancy of the axiomatic foundation of mathematical structures be apparent. In the section concerning cardinality of sets, besides arithmetic of finite sets, students classify types of infinite sets (finite, numerable, denumerable) and approach in an abstract way the notion of infinity in

relation with sets in common use as the sets of naturals, integers, rationals, and reals.
A major course learning outcome is that assimilation of the offered knowledge will create a good qualitative background so that students be able to proceed with adequacy to studying other branches of mathematics.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Analysis and synthesis of data and information
- Individual work
- Team work
- Production of creative and inductive thinking
- Production of analytical and synthetic thinking

SYLLABUS

Definition of trigonometric numbers, trigonometric cycle. Trigonometric numbers of the sum of two angles and trigonometric numbers of the double of an arc. Trigonometrical functions. Trigonometrical equations. Transformations of products to sum and of sums to products.
Elements of Logic. Basic set theory, operations and properties, power set, Cartesian products, collections. Relations, properties, equivalence relations, order relations, bounded sets, well ordered sets, principle of infinite reduction, functions, one to one functions, onto functions,
Image and preimage of a set, functions and ordered sets. Families. The set of real numbers: axiomatic approach. The sets of natural numbers, integers. The field of rational numbers. Roots of nonnegative real numbers. The set if irrational numbers.
The axiom of completeness and equivalent statements. Equivalent sets. Finite sets. Infinite sets. Schroder-Bernstein theorem. Numerable sets. At most numerable sets. Denumerable sets. Cantor' theorem. Axiom of Choice and equivalent statements. A first approach to the necessity of an axiomatic foundation of sets.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS	

TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT (Tex, Mathematica etc.) for presentation of essays and assignments.
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures</td><td>65</td></tr><tr><td>Homework</td><td>22,5</td></tr><tr><td>Individual work</td><td>100</td></tr><tr><td></td><td></td></tr><tr><td>Course total</td><td>**187,5**</td></tr></table>
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examination at the end of the semester including theory and problems-exercises.

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Παναγιώτης Χρ. Τσαμάτος, Θεμελιώδεις Έννοιες Μαθηματικής Ανάλυσης, Εκδόσεις Τζιόλα, 2009.
- Α. Τσολομύτης, Σύνολα και Αριθμοί, Leader Books, 2004.
- K. G. Binmore, Logic, Sets and Numbers, Cambridge University Press, 1980.
- W. W. Fairchild and C. I. Tulcea, Sets, W. B. Shaunders Co. Philadelphia, 1970.
- S. Lipschutz, Set Theory and Related Topics, Schaum's Outline Series, New York, 1965.
- D. Van Dalen, H. C. Doets and H. Deswart, Sets: Naïve, Axiomatic and Applied, Pergamon Press, Oxford, 1987.

COURSE OUTLINE
MAY121 – LINEAR ALGEBRA I

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY121**	**SEMESTER**	1st
COURSE TITLE	**Linear Algebra I**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		5	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://users.uoi.gr/abeligia/LinearAlgebraI/LAI2018/LAI2018.html		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes.*

After finsihing the course, the students will be able:

- to use matrices as a tool in theoretical or numerical computations
- to compute the rank of a matrix
- to compute determinants
- to solve linear systems of equations
- to understand and use the notion of vector space.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
The aim of the course is to empower the graduate to analyse and compose basic notions and knowledge of Linear Algebra and advance his creative and productive thinking.

SYLLABUS

- The algebra of (m x n) matrices and applications.
- Row echelon forms and reduced row echelon form of a matrix.
- Rank of a matrix. Determinants. Invertible matrices.
- Linear systems and applications.
- Vector spaces. Linear maps.
- The space L(E,F) of linear operations.
- Subspaces. Bases. Dimension. Rank of a linear operation.
- Fundamental equation of dimension and its applications. Matrix of a linear map. Matrix of a change of bases. The isomorphism between linear mapsand matrices. Equivalent matrices. Similar matrices. Determinant of an endomorphism. Sum and direct sum of vector subspaces.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	- Teaching Material: Teaching material in electronic form available at the home page of the course. - Communication with the students: 1. Office hours for the students (questions and problem solving). 2. Email correspondence 3. Weekly updates of the homepage of the course.
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art*	see table below

Activity	***Semester workload***
Lectures (13X5)	65
Working independently	100
Exercises-Homeworks	22.5
Course total	**187.5**

workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students, in English) which includes analysis of theoretical topics and resolving application problems.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Introduction to Linear Algebra (Greek), Bozapalidis Symeon, ISBN: 978-960-99293-5-6 (Editor): Charalambos Nik. Aivazis
- An Introduction to Linear Algebra, 2012, (Greek) Varsos Dimitris, Deriziwtis Dimitris, Emmanouil Giannis, Maliakas Mixalis, Melas Antonios, Talleli Olympia ISBN: 978-960-6706-36-3 (Editor): “Sofia” Editions
- Introduction to LINEAR ALGEBRA, 2006, (Greek) Theodora Theochari, Hara Haralambous, Charilaos Vavatsoulas, ISBN: 960-631-094-9, (Editor): Hara Charalambous

COURSE OUTLINE
MAY123 – NUMBER THEORY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY123**	**SEMESTER**	1st
COURSE TITLE	**Number Theory**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		4	7,5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek, English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://users.uoi.gr/abeligia/NumberTheory/NT2016/NT2016.html		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The main purpose of the course is the study of the structure and basic properties of natural numbers, and more generally of integers. This study is based on the fundamental concept of divisibility of integers, and the (unique) factorization of a natural number into prime factors.
The most important ideas, concepts and results that allow us to understand the structure and fundamental properties of all positive integers with respect to divisibility, are as follows (Keywords of course):
- Divisibility, prime numbers, Euclidean algorithm, greatest common divisor and least common multiple.
- Congruences and systems of congruences, Chinese remainder theorem.

- Arithmetical functions and Moebius inversion formula. Euler's ϕ-function.
- Theorems of Fermat, Euler and Wilson.
- Primitive mod p roots. Theory of indices and quadratic residues.
- Law of quadratic reciprocity.
- Applications to cryptosystems.

We will formulate and prove several theorems concerning the structure of all integers through the concept of divisibility. During the course will analyse applications of Number Theory to other sciences, and particularly to Cryptography.
This course is an introduction to the basic results, the basic methods, and the basic problems of elementary number theory, and requires no special knowledge of other subjects of the curriculum.
At the end of the course we expect the student to (a) have understood the definitions and basic theorems concerning the divisibility structure of the integers which are discussed in the course, (b) to have understood how they are applied in discrete examples, (c) to be able to apply the material in order to extract new elementary conclusions, and finally (d) to perform some (no so obvious) calculations.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

The course aims to enable the undergraduate student to acquire the ability to analyse and synthesize basic knowledge of the theory of numbers, to apply basic examples in other areas, and in particular to solve concrete problems concerning properties of numbers occurring in everyday life. The contact of the undergraduate student with the ideas and concepts of number theory, (a) promotes the creative, analytical and deductive thinking and the ability to work independently, (b) improves his critical thinking and his ability to apply abstract knowledge in various field.

SYLLABUS

- Complex numbers.
- Divisibility.
- Congruences mod m.
- Chinese remainder theorem.
- Arithmetical functions and Moebius inversion formula.
- The theorems of Fermat, Euler and Wilson.
- Primitive roots mod p.
- The theory of indices and the Law of quadratic reciprocity.
- Applications to cryptography.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face to face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	- Teaching Material: Teaching material in electronic form available at the home page of the course. - Communication with the students: 1. Office hours for the students (questions and problem solving). 2. Email correspondence 3. Weekly updates of the homepage of the course.
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	(see workload table below)
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, art interpretation, other Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students, in English) which includes analysis of theoretical topics and resolving application problems.

Activity	***Semester workload***
Lectures (13x4)	52
Working independently	104
Exercises - Homeworks	31.5
Course total	**187.5**

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- D. Poulakis: "*Number theory*", Ziti Press, (1997).
- D. Deriziotis: *"An introduction to Number theory*'', Sofia Press, (2007).

COURSE OUTLINE
MAY211 – INFINITESIMAL CALCULUS II

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY211**	**SEMESTER**	2nd
COURSE TITLE	**Infinitesimal Calculus II**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		5	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background		
PREREQUISITE COURSES	None (from the typical point of view). Without the knowledge earned from the course “Infinitesimal Calculus I” will be nearly impossible to follow this course.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (exams in English are provided for foreign students)		
COURSE WEBSITE (URL)	http://www.math.uoi.gr/GR/studies/undergraduate/courses/may211.htm		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

This course is the sequel of the course “Infinitesimal Calculus I”. The student will get in contact with more notions and techniques in the branch of Analysis. In this course the students:

- Are taught the notions of convergence and absolute convergence of series. They learn criteria and theorems concerning these notions as well as they learn how to compute sums of series. They are introduced in the notion of power series and they learn how to calculate the radius of convergence of a power series.

• Are taught the notion of uniform continuity and they learn to distinguish this notion from continuity. • Are taught the notion of Riemann integral and various theorems concerning this notion. They also learn various integrating techniques. • Are taught Taylor's theorem and they learn to write a given function as a Taylor series.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
The course provides inductive and analytical thinking, the students evolve their computational skills and they get knowledge necessary for other courses during their undergraduate studies.

SYLLABUS

Series, convergence of series and criteria for convergence of series. Dirichlet's criterion, D' Alembert's criterion, Cauchy's criterion, integral criterion. Series with alternating signs and Leibnitz's theorem. Absolute convergence and reordering of series, Power series, radius of convergence of power series. Uniform continuity, definition and properties. Characterization of uniform continuity via sequences. Uniform continuity of continuous functions defined on closed intervals. Riemann integral, definition for bounded functions defined on closed intervals. Riemann's criterion, integrability of continuous functions. Indefinite integral and the Fundamental theorem of Calculus. Mean Value theorem of integral calculus, integration by parts, integration by substitution. Integrals of basic functions, integrations of rational functions. Applications of integrals, generalized integrals, relation between generalized integrals and series. Taylor polynomials, Taylor's Theorem, forms of the Taylor remainder. Taylor series and expansions of some basic functions as Taylor series.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Due to the theoretical nature of this course the teaching is exclusively given in the blackboard by the teacher.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory*	The students may contact their teachers by electronic means, i.e. by e-mail.

<table>
<tr><td>education, communication with students</td><td></td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (13X5)</td><td>65</td></tr>
<tr><td>Solutions of exercises</td><td>22,5</td></tr>
<tr><td>Individual study</td><td>100</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>187,5</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Exams in the end of the semester (mandatory).
Assignments of exercises during the semester (optional).</td></tr>
</table>

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Γενικά Μαθηματικά - Απειροστικος Λογισμός τόμος Ι, Χ. Αθανασιάδης, Ε. Γιαννακούλιας, Σ. Γιωτόπουλος, Εκδόσεις Συμμετρία.
- “Απειροστικός Λογισμός Τόμος ΙΙα” Σ. Νεγρεπόντης, Σ. Γιωτόπουλος, Ε. Γιαννακούλιας, Εκδόσεις Ζήτη.
- “Απειροστικός Λογισμός τομος Β”, Σ. Ντούγιας, Leader Books.
- “Thomas, Απειροστικός Λογισμός”, R.L. Finney, M.D. Weir, F.R.Giordano, Πανεπιστημιακές Εκδόσεις Κρήτης, (Απόδοση στα ελληνικά: Μ. Αντωνογιαννάκης).
- “Διαφορικός και Ολοκληρωρικός Λογισμός: Μια εισαγωγή στην Ανάλυση”, Michael Spivak, Πανεπιστημιακές Εκδόσεις Κρήτης (Μετάφραση στα ελληνικά: Α. Γιαννόπουλος).

COURSE OUTLINE
MAY221 – LINEAR ALGEBRA II

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY221**	**SEMESTER**	2nd
COURSE TITLE	**Linear Algebra II**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises		5	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://users.uoi.gr/abeligia/LinearAlgebraII/LAII2018/LAII2018.html		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes.*

After finishing the course, the students will be able:
- to compute eigenvalues and eigenvectors
- to diagonalize matrices
- to compute othocanonical bases, orthogonal complements and orthogonal projections to subspaces
- to diagonalise symmetric matrices using orthogonal matrices
- to compute the invariants of quadratic forms.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment*	*Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
The aim of the course is to empower the graduate to analyse and compose notions and knowledge of Linear Algebra and advance creative and productive thinking.	

SYLLABUS

Eigenvalues, Eigenvectors, Eigenspaces, Diagonalisation, Cauley-Hamilton thoerem, Euclidean spaces, Orthogonality, Gram-Schmidt orthogonalization, Orthogonal matrices, Self-adjoint endomorphisms, Symmetric matrices, Spectral theorem, Isometries, Quadratic forms, Principal Axes, Square root of a nonnegative real symmetric matrix. Norms of a matrix.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study*	see table below

Activity	*Semester workload*
Lectures (13X5)	65
Working independently	100
Exercises-Homeworks	22.5
Course total	**187.5**

according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English) which includes resolving application problems.

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Introduction to Linear Algebra (Greek), Bozapalidis Symeon, ISBN: 978-960-99293-5-6 (Editor): Charalambos Nik. Aivazis
- An Intorduction to Linear Algebra, 2012, (Greek) Varsos Dimitris, Deriziwtis Dimitris, Emmanouil Giannis, Maliakas Mixalis, Melas Antonios, Talleli Olympia ISBN: 978-960-6706-36-3 (Editor): “Sofia” Editions
- Introduction to LINEAR ALGEBRA, 2006, Theodora Theochari, Hara Haralambous, Charilaos Vavatsoulas, (Greek) ISBN: 960-631-094-9, (Editor): Hara Charalambous

COURSE OUTLINE
MAY223 – ANALYTIC GEOMETRY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY223**	**SEMESTER**	2nd
COURSE TITLE	**Analytic Geometry**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises		5	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek, English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes.*

It is an introductory course on geometry. The aim is to study problems in geometry using rectangular coordinates and tools based on Linear Algebra.

On completion of the course the student should be familiar with basic notions in geometry like the one of isometry. Furthermore, the student should have a background to allow him to attain more advanced courses on geometry, calculus of several variables and others.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these

appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment*	*Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*

- Working independently
- Decision-making
- Production of free, creative and inductive thinking
- Criticism and self-criticism

SYLLABUS

Axioms of Euclidean geometry (plane and space) and proofs of basic propositions. Cartesian model, vectors, linear independence, bases, coordinates and applications. Inner product, cross product, area, volume and determinants. Lines and planes. Geometric transformations (parallel transports, rotations, reflections), isometries and the notion of congruence. Transformation of area and volume under linear transformations. Curves and surfaces of 2^{nd} degree and their classification. Curves, surfaces and parametrizations.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each*	see table below

Activity	***Semester workload***
Lectures (13X5)	65
Working independently	100
Exercises-Homeworks	22.5
Course total	**187.5**

learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English) which includes resolving application problems.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Thomas F. Banchoff και John Wermer, Η Γραμμική Άλγεβρα μέσω Γεωμετρίας, Εκδόσεις Leader Books, Σειρά Πανεπιστήμιακα Μαθηματικά Κείμενα, Αθήνα, 2009.

COURSE OUTLINE
MAY242 – INTRODUCTION TO COMPUTERS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY242**	**SEMESTER**	2nd
COURSE TITLE	**Introduction to Computers**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures and laboratory exercises		5	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course:

- is a general introduction to computers and their use
- focuses in the process of designing algorithms for the solution of simple as well as more complex problems which are of general interest but also problems in the area of mathematics. For the description of the algorithms a pseudocode language or flow diagrams are used and it provides basic principles of computer programming using a high level programming language such as C/C++ for the solution of the problems in (2) and the coding of the corresponding algorithms.

After completing the course the student:

- Can identify the different parts of a computer and knows the hardware and software that make up the computer system. Understands the basic internal operation of a computer.
- Can describe basic algorithms using flowcharts or pseudocode for the solution of a problem. Is able to create a program using the basic features of a programming language (C/C++).

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Working independently
- Description of the solution process of problems using flow diagrams or a pseudocode language
- Implementing algorithms in C and C++
- Solving a problem using a computer

SYLLABUS

1. Computer - Hardware, Software
2. Binary system - data representation
3. Algorithms description methods, Flow diagrams, Greek algorithmic language
4. Program Design
5. Basic features of the programming language C/C++, Integrated development environment
6. Basic data types
7. Operators, Arithmetic / Logic expressions
8. Assignment operators
9. Input / Output
10. Program flow control commands
11. Selection commands
12. Loop commands
13. Arrays
14. Introduction to user defined functions
15. Applications, examples, and exercises in problem solving of simple and complex problems using C/C++
16. The course includes laboratory exercises

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Yes
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	see table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written final exam (70%) comprised of: • multiple choice questions related to the theory of computers and the programming language C/C++ • questions about the design and implementation of algorithm for the solution of problems using C/C++ Laboratory exercises (30%).

Activity	***Semester workload***
Lectures (13X5)	65
Self study	100
Exercises	22.5
Course total	**187.5**

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Teach yourself C ++, Herbert Schildt.
- C Programming, Deitel Harvey M., Deitel Paul J.
- C ++ Programming 6th Edition, Deitel Harvey M., Deitel Paul J.
- Complete C++, Savitch Walter.
- C++, 9t h Edition, Savitch Walter
- C++ for Mathematicians: An Introduction for Students and Teachers, Edward Scheinerman.

Websites for C/C++

- www.cplusplus.com
- www.cprogramming.com/
- www.tutorialspoint.com/cplusplus
- www.learncpp.com

COURSE OUTLINE
MAY311 – INFINITESIMAL CALCULUS III

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY311**	**SEMESTER**	3rd
COURSE TITLE	**Infinitesimal Calculus III**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises		5	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek, English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://users.uoi.gr/giannoul/AL3.html		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area • Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B • Guidelines for writing Learning Outcomes.
The main learning outcomes are the: • differentiability analysis of real- and vector-valued functions of several variables • familiarity with the Euclidean space from an analytic (topological) viewpoint • knowledge of the problems that arise in Analysis in several dimensions • preparation for the treatment of functions of several variables in more specialized courses, e.g., Partial Differential Equations, Differential Geometry, Classical Mechanics, Application of Mathematics in the Sciences • development of combination skills concerning knowledge from diverse areas of Mathematics (Linear Algebra, Analytical Geometry, Analysis).

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology • Adapting to new situations • Working independently • Criticism and self-criticism • Production of free, creative and inductive thinking

SYLLABUS

- Algebraic and topological structure of the Euclidean space R^n and geometric representation of the two- and three-dimensional space. Vector-sequences and their use concerning the topology of R^n.
- Real- and Vector-valued functions of several variables. Limits and continuity of functions.
- Partial derivatives. Partially differentiable and differentiable functions. Directional derivative. Differential operators and curves in R^n.
- Higher order partial derivatives. Taylor Theorem. Local and global extrema of real-valued functions. Implicit Function Theorem. Inverse Function Theorem. Constrained extrema.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Teaching material is offered at the course's website (notes and older exams) • The students may contact the lecturer by e-mail
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials,*	see table below

Activity	*Semester workload*
Lectures (13X5)	65
Working independently	100
Exercises-Homeworks	22.5
Course total	**187.5**

placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English)

ATTACHED BIBLIOGRAPHY

Suggested bibliography:

- J. E. Marsden, A. Tromba: Vector Calculus, 6th edition, W. H. Freeman and Company, 2012
- M. Spivak: Calculus on Manifolds, Addison-Wesley, 1965
- Ι. Γιαννούλης: Διανυσματική Ανάλυση, ΣΕΑΒ, 2015 (in Greek)

COURSE OUTLINE
MAY331 - INTRODUCTION TO PROBABILITY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY331**	**SEMESTER**	3rd
COURSE TITLE	**Introduction to Probability**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		5	7,5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English, reading Course)		
COURSE WEBSITE (URL)	http://users.uoi.gr/kzograf/SyllabousProbabilityEnglish.pdf		

LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of this course is to provide with a comprehensive understanding of the basic definitions of probability and the basic principles and laws of probability theory. Further, the introduction to the concepts of the random variable and the distribution function, as well as, their characteristics, such as the mean, variance, moments, moment generating function, etc., is included in the main aims of the course. Special distributions, such as binomial, geometric, Pascal, Poisson, uniform, exponential, gamma, normal distribution, etc. are studied and their use and application is indicated.
The course is compulsory, it is of an entry-level and it aims to develop skills that help the students to understand, design and exploit stochastic models to describe real problems. At the end of the course the students is expected to be able to:
- Exploit and apply the classical and empirical definition of probability in order to calculate

probabilities, by using combinatorial analysis. • Utilize the axiomatic foundation of the concept of probability and use it in order to derive and prove probabilistic laws and properties. • Understand and utilize classical probabilistic laws as the multiplicative theorem, the total probability theorem, Bayes' formula, and independence for modeling respective problems. Emphasis is given to the use of interdisciplinary problems which are modeled by the application of the above probabilistic rules. • Understand the necessity of introducing and studying the concept of random variable, its characteristics (mean, variance, etc.) and the corresponding probability distribution. Special discrete and continuous distributions are defined and utilized for the description, analysis and study real problems from different areas (lifetime distributions, reliability etc.).
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Working independently • Decision-making • Production of free, creative and inductive thinking • Criticism and self-criticism

SYLLABUS

Basic ideas and laws of probability: Sample space and events. Classical-Statistical and Axiomatic definition of probability. Properties of probability and probabilistic formulas and laws. Elements of combinatorial analysis. Random variables and distribution functions. Discrete and continuous random variables and distribution functions. Standard discrete and continuous distributions: Binomial, Geometric, Pescal, Poisson, Uniform, Exponential, gamma, Normal etc. Characteristics of random variables and probability distributions: Expectation, variance, moments, moment generating function, properties. Transformation of random variables.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory*	Use of ICT in communication with students

<table>
<tr><td>education, communication with students</td><td></td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (13X5)</td><td>65</td></tr>
<tr><td>Working independently</td><td>100</td></tr>
<tr><td>Exercises-Homeworks</td><td>22,5</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>187,5</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, art interpretation, other
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exam in Greek (in case of Erasmus students in English) which concentrates on the solution of problems which are motivated by the main themes of the course.</td></tr>
</table>

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

Books in English

- Ross, S. (1998). A First Course in Probability. 5th Edition. Prentice Hall, Inc.
- Roussas, G. (2007). Introduction to Probability. Academic Press.

Books in Greek

- Ζωγράφος, Κ. (2008). Πιθανότητες, Πανεπιστήμιο Ιωαννίνων.
- Hoel, P., Port, S. and Stone, C. (2001). Εισαγωγή στη Θεωρία Πιθανοτήτων. Πανεπιστημιακές Εκδόσεις Κρήτης.
- Κουνιά, Σ. και Μωϋσιάδη, Χ. (1995). Θεωρία Πιθανοτήτων Ι. Εκδόσεις Ζήτη, Θεσσαλονίκη.
- Κούτρας, Μ. (2012). Εισαγωγή στη Θεωρία Πιθανοτήτων και Εφαρμογές. Εκδόσεις Α. Σταμούλης. Αθήνα.
- Παπαϊωάννου, Τ. (2000). Εισαγωγή στις Πιθανότητες. Εκδόσεις Α. Σταμούλης. Αθήνα.
- Χαραλαμπίδη, Χ. (1990). Θεωρία Πιθανοτήτων και Εφαρμογές. Τεύχος 1. Εκδόσεις Συμμετρία. Αθήνα.

COURSE OUTLINE
MAY341–INTRODUCTION TO NUMERICAL ANALYSIS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY341**	**SEMESTER**	3rd
COURSE TITLE	**Introduction to Numerical Analysis**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		4	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
After successful end of this course, students will be able to: • know the behavior of roundoff errors in computations and to choose stable methods for the solution of problems, • be aware and apply the taught methods for the solution of nonlinear equations and to study their convergence, • be aware and apply the basic direct and iterative methods for the solution of linear systems of equations, to know their advantages and to choose the appropriate method, • be aware and apply the taught methods to approximate functions by polynomial interpolation, • be aware and apply the taught methods to approximate integrals of functions by numerical

integration and to study the behavior of the errors, • implement the above methods with programs on the computer.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology • Adapting to new situations • Criticism and self-criticism • Production of free, creative and inductive thinking

SYLLABUS

Error Analysis. Numerical Solution of Nonlinear Equations: Iterative Methods, Newton’s Method, Secant Method. Numerical Solution of Linear Systems: Direct Methods (Gauss Elimination, LU factorization), Iterative Methods (Jacobi, Gauss-Seidel). Polynomial Interpolation: Lagrange method, Method of divided differences of Newton. Numerical Integration: Simple and Generated Rules of Numerical Integration, Trapezoidal Rule, Simpson’s Rule, Error analysis of Numerical Integration.

TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>In the class</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td></td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (13X4)</td><td>52</td></tr>
<tr><td>Study and analysis of bibliografy</td><td>104</td></tr>
<tr><td>Exercises-Homeworks</td><td>31.5</td></tr>
<tr><td>Course total</td><td>187.5</td></tr>
</table>
</td></tr>
</table>

workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examination.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- “Introduction to Numerical Analysis”. Akrivis G.D., Dougalis B.A, Crete University Press, 4^{th} Edition, 2010.
- “Numerical Analysis: Introduction”, Vrachatis M.N, Klidarithmos Press, 2011.

COURSE OUTLINE
MAY343 – INTRODUCTION TO PROGRAMMING

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY343**	**SEMESTER**	3rd
COURSE TITLE	**Introduction to Programming**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises, tutorials, quiz		5	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://www.cs.uoi.gr/~charis/c343/		

LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

This course aims at introducing to students the philosophy of programming and at giving them the ability to implement algorithms in C/C++.
After successfully passing this course the students will be able to:
- Write simple or complex programs
- Verify the correctness and appropriateness of a given program
- Debug programs
- Understand basic programming concepts, structures and techniques
- Use arrays, strings, and functions
- Conduct simple and complex arithmetic computations via programming

- Use control flow constructs, conditions, decision structures and loops
- Structure their programs with the help of iterative and recursive functions
- Program basic operations on data, such as searching and sorting.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work
- Project planning and management.

SYLLABUS

- Introduction to programming and binary representation
- Input/Output, data structures and variables
- Preprocessing, numerical, boolean and logical operators
- Flow control: if/else, switch, for, while, do-while
- Structuring, locality of parameters, pass by value/reference, variable scope, recursive functions, program stack.
- Arrays
- Searching and sorting data
- String operations
- Type and data structures and file processing.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, labs session
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of projector and interactive board during lectures. • Use of computer for demonstation of programming. • Use of computers in laboratories for development and testing of programs. • Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs).

<table>
<tr><td></td><td>

- Announcement of assessment marks via the ecourse platform by UOI.

</td></tr>
<tr><td>

TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS

</td><td>

Activity	***Semester workload***
Lectures (13X5)	65
Laboratory practice	100
Tutorials	22.5
Course total	**187.5**

</td></tr>
<tr><td>

STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

</td><td>

Final written examination (80%)

- Multiple choice questions
- Develop programs

Laboratory exercises (20%)

- Multiple choice questions
- Develop programs

</td></tr>
</table>

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- W. Savitch, Πλήρης C++, Εκδόσεις Τζιόλα, 2011. Κωδικός Ευδ: 18548892
- H. Deitel and P. Deitel, C++ Προγραμματισμός 6η Εκδοση, Εκδόσεις Μ. Γκιούρδας, 2013. Κωδικός Ευδ: 12536819
- L. Jesse, Πλήρες εγχειρίδιο της C++, Εκδόσεις Α. Γκιούρδα, 2006. Κωδικός Ευδ: 12374
- Ν. Χατζηγιαννάκης, Η γλώσσα C++ σε βάθος, Εκδόσεις Κλειδάριθμος, 2008. Κωδικός Ευδ: 13761.

COURSE OUTLINE
MAY411 – INFINITESIMAL CALCULUS IV

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY411**	**SEMESTER**	4th
COURSE TITLE	**Infinitesimal Calculus IV**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		5	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	• Language of Instruction (lectures): Greek • Language of Instruction (activities other than lectures): Greek and English • Language of Examinations: Greek and English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	Course description: http://math.uoi.gr (go to: Studies -> UnderGraduate Studies -> Courses) Learning Management System (e.g.: Moodle): http://users.uoi.gr/kmavridi (go to: Courses)		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Here, the acronym VFomV stands for Vector Function of multiple Variables.
Learning outcomes according to Bloom Taxonomy:
Remembering:

- The concept of the integral of VFomV. Basic properties of this integral.

- The concept of improper integral of VFomV. Basic properties of this integral.
- The concept of integrals of VFomV over paths and surfaces. Basic properties of this integral.
- The concepts of vector field and gradient field.
- The concepts of the sequence of VFomVs, of uniform convergence of such sequences, of the series of such sequences and of the Fourier series.

Comprehension:

- Integration of VFomV over a rectangle and over an elementary region.
- Changing the order of integration.
- Integration over vector fields and gradient fields.
- The Stokes, Green and Gauss Theorems.

Applying:

- Finding length of path, area of elementary region, volume of solid body.
- Finding curvature of surfaces and minimal surfaces.
- Conservative fields and their applications in Physics.
- Study of liquid fluids and study of waves.
- Differential forms and their applications in Differential Geometry.

Analyzing: (none)
Synthesizing: (none)
Evaluating: Teaching undergraduate and graduate courses.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Creative, analytical and inductive thinking.
- Required for the creation of new scientific ideas.
- Working independently.
- Working in groups.
- Decision making.

SYLLABUS

Definition of multiple integral using lower and upper sums over closed rectangles, set of zero volume, Lebesgue Criterion for Riemann Integrability, Jordan measurable sets and the definition of the integral over such sets, Fubini Theorem, Cavalieri Principle, elementary regions in two and three dimensional spaces, change of variables and their basic applications, evaluation of integrals using the

aforementioned methods.
Definition of integrals over paths for parametrizes functions an vector fields, definition of path length, parametrizes paths, parametrized transformations, gradient fields and path independent integrals, Green Theorem.
Surfaces and parametrization of surface integrals. Definition of surface integral for real functions and for vector fields. Area of surface. Stokes and Gauss Theorems.
Uniform convergence of function's sequences and series. Fourier series.

TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>• Lectures in class.
• Learning Management System (e.g.: Moodle).</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of Learning Management System (e.g.: Moodle), combined with File Sharing and Communication Platform (e.g.: NextCloud) for
1. distributing teaching material,
2. submission of assignments,
3. course announcements,
4. gradebook keeping for all students evaluation procedures,
5. communicating with students.

Use of Web Appointment Scheduling System (e.g.: Easy!Appointments) for organising office appointments.
Use of Google services for submitting anonymous evaluations regarding the teacher.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td>Lectures (13X5)</td><td>65</td></tr><tr><td>Study and analysis of bibliography</td><td>100</td></tr><tr><td>Preparation of assignments and interactive teaching</td><td>22.5</td></tr><tr><td></td><td></td></tr><tr><td>Course total</td><td>187.5</td></tr></table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice</td><td>Language of evaluation: Greek and English.

Methods of evaluation:
• Weekly written assignments.
• Few number of tests during the semester.
• Based on their grades in the aforementioned weekly assignments and tests, limited number of students can</td></tr>
</table>

questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	participate in exams towards the end of the semester, before the beginning of the exams period. • In any case, all students can participate in written exams at the end of the semester, during the exams period. The aforementioned information along with all the required details are available through the course's website. The information is explained in detail at the beginning of the semester, as well as, throughout the semester, during the lectures. Reminders are also posted at the beginning of the semester and throughout the semester, through the course's website. Upon request, all the information is provided using email or social networks.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:(see Eudoxus) *- Related academic journals: (see Eudoxus)*

COURSE OUTLINE
MAY413 - INTRODUCTION TO TOPOLOGY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY413**	**SEMESTER**	4th
COURSE TITLE	**Introduction to Topology**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		5	7,5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://www.math.uoi.gr/GR/studies/undergraduate/courses/413.html		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
Topology is a powerful tool for research and expression in all branches of Mathematical Science. In the last few years, Topology has been increasingly used in the creation of mathematical models that serve research applied disciplines such as Economics, Meteorology, Insurance Mathematics, Epidemiology in Medicine, etc. The didactic approach here is to initially give the theory of metric spaces and then, as a mere reference, an introduction to General Topology. An in-depth study of Metric spaces, in addition to preparing the student to accept the abstract structures of General Topology, helps him to better understand the structure of the Euclidean space $\mathbb{R}^n$, which is studied the same time in the Multi-Variable Infinitesimal Calculus.

Topics which are covered are convergence, continuity, completeness, total boundness, compactness, separability and connectedness. These concepts, as well as the proofs of the related results, are given in such a way that, wherever possible, they can be easily and without major changes adapted toTopological Spaces.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment*	*Production of new research ideas Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others…*

- Analysis and synthesis of data and information
- Autonomous work
- Teamwork
- Working in an interdisciplinary environment
- Promoting creative and inductive thinking
- Promoting analytical and synthetic thinking
- Production of new research ideas.

SYLLABUS

Metric spaces, definition, examples, basic properties. Metrics in vector spaces induced by norms. Diameter of a set, distance of sets. Sequences in metric spaces, subsequences, convergence of sequences. Functions between metric spaces, continuous functions, characterization of continuity via sequences, uniform continuity of functions. Open balls, closed balls, interior, closed hull and boundary, accumulation points and derived set. The topology of a metric space, the concept of a topological space. Basic (or Cauchy) sequences, complete metric spaces. Principle of contraction (Banach's Fixed Point Theorem). Totally bounded metric spaces, compact spaces. Equivalent forms of compactness of metric spaces. Properties of compact spaces. Separable metric spaces. Connectedness in metric spaces, properties of connected sets, connected components.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT for presentation of essays and assignments
TEACHING METHODS *The manner and methods of teaching are*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures</td><td>65</td></tr></table>

described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	Solving exercises at home	22,5
	Individual study	100
	Course total	**187,5**
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examination at the end of the semester including theory and problems-exercises.	

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- K. W. Anderson and D. W. Hall, Sers, Sequences and Mappings, John Wiley and Sons, Inc. New York 1963.
- V. Arkhangel'skii and V.I. Ponomarev, Fundamentals of General topology, D. Reidel Publishing Company, 1983.
- G. Buskes and A. van Rooij, Topological Spaces, Springer-Verlag, New York, 1197.
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- Χ. Καρυοφύλη και Χ. Κωνσταντιλάκη, Τοπολογία, Ι, ΙΙ, Εκδόσεις Ζήτη, Θεσσαλονίκη 1990.
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- S. Lipschutz, Theory and Problems of General Topology, Schaum's Outline Series, New York, 1965.
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- M. G. Murdeshuar, General Topology, Wiley Eastern Limited, New Delhi, 1986.
- M. H. A. Newman, Elements of the Topology of Plane Sets of Points, Cambridge University Press, 1964.
- A. W. Schurle, Topics in Topology, North Holland, New York, 1979.
- Β. Στάϊκος, Μαθήματα Μαθηματικής Αναλύσεως Μέρος Ι και Μέρος ΙΙ, Ιωάννινα, 1981.
- Π. Τσαμάτος, Τοπολογία, 2η ΄Εκδοση, Παναγιώτης, Εκδόσεις Τζιόλα.

COURSE OUTLINE
MAY422 - ALGEBRAIC STRUCTURES I

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY422**	**SEMESTER**	4th
COURSE TITLE	**Algebraic Structures I**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		5	7,5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek, English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://users.uoi.gr/abeligia/AlgebraicStructuresI/ASI2017/ASI2017.html		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The course aims to introduce the students to the study algebraic properties of sets which are equipped with one or more (binary) operations. Such mathematical objects are called algebraic structures. We will mainly deal with two types of algebraic structures: • Groups. The standard example is the group of permutations of a, usually finite, set. This is the set of all bijective functions from a set to itself endowed with the operation of composition of functions. • Rings. The standard example of a ring is the set of integers equipped with the operations of addition and multiplication of integers. We will formulate various theorems concerning the structure and basic properties of groups and rings emphasizing the concept of isomorphism of groups or rings. From the perspective of Algebra two

algebraic structures which are isomorphic, they have exactly the same algebraic properties. As a direct consequence, results concerning an algebraic structure are valid in any isomorphic algebraic structure. In the course we present several examples illuminating various notions of symmetry. It should be noted that the notion of symmetry is the central theme which underlies the concept of group/ring.
At the end of the course we expect the student: (a) to have understood the definitions and basic theorems which are discussed in the course, (b) to have understood how they are applied in discrete examples, (c) to be able to apply the material in order to extract new elementary conclusions, and finally (d) to perform some (no so obvious) calculations.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

The course aims to enable the undergraduate student to acquire the ability to analyse and synthesize basic knowledge of the theory of algebraic structures, in particular of the general theory of Groups and Rings, which form an important part of modern algebra. The contact of the undergraduate student with the ideas and concepts of the theory of groups and rings, (a) promotes the creative, analytical and deductive thinking and the ability to work independently, (b) improves his critical thinking and his ability to apply abstract knowledge in various field.

SYLLABUS

- Preliminaries: Sets, functions, equivalence relations, partitions, (binary) operations.
- Groups – Permutation groups.
- Cyclic groups – generators.
- Cosets with respect to a subgroup – Lagrange's Theorem.
- Homomorphisms of groups – Quotient groups.
- Rings and fields - Integral domains.
- The theorems of Fermat and Euler.
- Polynomial rings – Homomorphisms of Rings.
- Quotient rings – Prime and maximal ideals.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face to face)

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	- Teaching Material: Teaching material in electronic form available at the home page of the course. - Communication with the students: • Office hours for the students (questions and problem solving). • Email correspondence • Weekly updates of the homepage of the course.
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	see table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students, in English) which includes analysis of theoretical topics and resolving application problems.

Activity	*Semester workload*
Lectures (13x5)	65
Working independently	100
Exercises-Homeworks	22.5
Course total	**187,5**

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- J. Fraleigh: "*Introduction to Algebra*", Greek edition, Crete University Press, (2005).
- D. Varsos, D. Deriziotis, M. Maliakas, O. Talleli, I. Emmanouil**:** "*An Introduction to Algebra*", Sofia Press, (2007).
- K. Kalfa: "*Introduction to Algebra*", Ziti Press, (2003).
- D. Poulakis: “Algebra”, Ziti Press, (2013).

COURSE OUTLINE
MAE431 - INTRODUCTION TO STATISTICS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE431**	**SEMESTER**	4th
COURSE TITLE	**Introduction to Statistics**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		4	7,5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English, reading Course)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
At the end of the course student should be able to: a) Understand the meaning of the population and the random sample. b) Present summary quantitative and qualitative data. c) Estimate unknown population parameters. d) Carry out basic statistical hypothesis, and finally, e) Be able to simply adapt linear regression models and conduct one way analysis of variance.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Working independently • Decision-making • Production of free, creative and inductive thinking • Criticism and self-criticism

SYLLABUS

Descriptive Statistics. Population, Samples & Random Samples. Frequencies, Histograms & Frequencies Statistics. Statistics & Sampling Distributions. χ2, t & F Distributions. Sampling from Normal Populations. Statistical Inference: Parameter Estimation & Tests of Hypotheses. Simple Linear Regression. One-Way & Two-Way Analysis of Variance.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each*	see table below

Activity	***Semester workload***
Lectures (13 X 4)	52
Working independently	104
Exercises-Homework	31,5
Course total	**187,5**

learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English).

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

Texts in English:

- Mendenhall, W., Scheaffer, R. L. and Wackerly, D. D.(1981). Mathematical Statistics with Applications. 2d ed. ISBN: 0-534-98019-8. Duxbury Press. Boston

Texts in Greek:

- Παπαιωάννου, Τ. και Λουκάς, Σ. 2002. Εισαγωγή στη Στατιστική. ISBN: 960-351- 409-8. Εκδόσεις Σταμούλη ΑΕ
- Κουνιάς, Σ., Κολύβα-Μαχαίρα, Φ., Μπαγιάτης, Κ., Μπόρα-Σέντα, Ε.(2001). Εισαγωγή στη Στατιστική. ISBN: 960-7577-15-9. Εκδότης Α. και Π. Χριστοδουλίδου Ο.Ε.

COURSE OUTLINE
MAY514 - INTRODUCTION TO DIFFERENTIAL EQUATIONS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergrafuate		
COURSE CODE	**MAY514**	**SEMESTER**	5th
COURSE TITLE	**Introduction to Differential Equations**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		5	7,5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	*General background*		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	Through the platform “e-course” of the University of Ioannina		

LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The course is the introductory course to ordinary differential equations and aims to a general introductory description of the area of ordinary differential equations. It is expected that the students take basic knowledge on:
- How to solve linear ordinary differential equations of first order and some equations of special types.
- Existence and uniqueness of solutions to ordinary differential equations
- General theory of linear o.d.e.
- How to solve linear equations and systems with constant coefficients.
- How to solve linear o.d.e. of second order by the use of power series.

• Use of Laplace transformations to solve o.d.e.. • How to solve first order linear partial differential equations.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Working independently • Production of free, creative and inductive thinking • Analytic and synthetic thinking

SYLLABUS

Introduction to differential equations and initial value problems. O.d.e.'s of some special types (Bernoulli, Riccati, Clairaut, Lagrange). Equations with separated variables. Exact equations. Integral factors. Second order equations reduced to first order equations. Existence and uniqueness theorems. General theory of linear o.d.e.'s. Linear equations and systems with constant coefficients. Power series solutions for second order d.e.'s. Partial differential equations: solutions to first order equations, classification of linear equations of second order. Applications of d.e.'s to problems arising in various areas of science and technology.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	*Face-to-face* (Lectures)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	The platform "e-course" of the University of Ioannina
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art*	

Activity	*Semester workload*
Lectures	45
Assignments,/Tests	52,5
Individual study	90
Course total	**187,5**

workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written Final Examination (Theory and Exercises) 100%

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Χ. Φίλος, Μία Εισαγωγή στις Διαφορικές Εξισώσεις
- Ν. Μυλωνάς, Χ. Σχοινάς, Διαφορικές Εξισώσεις, Μετασχηματισμοί και Μιγαδικές Συναρτήσεις
- Θ Κυβεντίδη, Διαφορικές Εξισώσεις
- R. Agarwal, D. O’Regan, H. Agarwal, Introductory Lectures on Ordinary Differential Equations
- F. Ayres, Differential Equations

COURSE OUTLINE
MAY522 - ELEMENTARY DIFFERENTIAL GEOMETRY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY522**	**SEMESTER**	5th
COURSE TITLE	**Elementary differential geometry**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		5	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://users.uoi.gr/tvlachos/		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

It is an introductory course on differential geometry. The aim is to introduce and study geometric properties of regular curves (both plane and space) and regular surfaces. Fundamental notions of differential geometry of curves and surfaces are introduced and studied. Among them is the notion of curvature. The study requires tools from Linear Algebra and Calculus of several variables.
Upon completion of the course, the student should be familiar with basic notions of differential geometry like the one of curvature, first and second fundamental form, isometries between surfaces and their geometric meaning.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Work autonomously
- Work in teams
- Develop critical thinking skills

SYLLABUS

Plane curves, arclength, curvature, Frenet frame.
Space curves, curvature and torsion, Frenet frame, fundamental theorem of curves.
Surfaces, parametrization, Gauss map, Weingarten map, first and second fundamental form, normal curvature, principal and asymptotic directions, Gaussian and mean curvature, minimal surfaces, Theorema Egregium, Gauss and Weingarten formulas, fundamental theorem of surfaces, developable surfaces.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Direct
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, art workshop, interactive teaching, educational visits, project, essay writing, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	see table below

Activity	***Semester workload***
Lectures	65
Autonomous study	127.5
Course total	**187.5**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written final examination

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Δ. Κουτρουφιώτης, Στοιχειώδης Διαφορική Γεωμετρία, Εκδόσεις Leader Books, 2006
- Barrett O' Neil, Στοιχειώδης Διαφορική Γεωμετρία, Πανεπιστημιακές Εκδόσεις Κρήτης, 2002
- Andrew Pressley, Στοιχειώδης Διαφορική Γεωμετρία, Πανεπιστημιακές Εκδόσεις Κρήτης, 2011
- Manfredo do Carmo, Differential Geometry of Curves and Surfaces, Prentice-Hall, 1976

COURSE OUTLINE
MAY611 – COMPLEX FUNCTIONS I

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAY611**	**SEMESTER**	6th
COURSE TITLE	**Complex Functions I**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Presentations, exercises, lectures	5	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)		

COURSE TYPE *general background, special background, specialised general knowledge, skills developmen*	General background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	http://www.math.uoi.gr/GR/studies/undergraduate/courses/perigr /MAE_611.pdf

LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described. *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
It is the most basic introductory course of Mathematical Analysis of the complex space. The student begins to understand the notion of complex numbers and their properties. He/she learns about the use of the complex numbers field in solving some real numbers problems. The student learns about the elementary complex functions and then he/she learns about the line integral as well as the complex integral of such functions. Especially, the advantage of such integrals and their important properties are emphasized. Finally, the student learns the use of complex integrals in computing improper integrals of real functions.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Working independently • Team work • Working in an international environment • Working in an interdisciplinary environment • Production of new research ideas

SYLLABUS

The complex plane, Roots, Lines, Topology, Convergence, Riemann sphere, analytic properties of complex functions, Power series, elementary functions (rational, exp, log, trigonometric functions, hyperbolic, functions), line integrals, curves, conformal mappings, homotopic curves, local properties of complex functions, basic theorems, rotation index, General results, singularities, Laurent series, Residuum, Cauchy Theorem, Applications.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT for the presentation and communication for submission of the exercises
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay*	(see workload table below)

Activity	***Semester workload***
Lectures	65
Home exercises	22.5
Independent study	100
Course total	**187,5**

writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Greek. Written exam (100%) on the theory and solving problems.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- GEORGE L. KARAKOSTAS, INTRODUCTION TO COMPLEX ANALYSIS, KOSTARAKI ED., 2015 (Greek)
- Jeff Achter, Introduction to Complex Variables, Colorado State University, 2006.
- Lars V. Ahlfors, Complex Analysis, McGraw-Hill, 1966.
- Joseph Bak and Donald J. Newman, Complex analysis, Springer-Verlag, 1982.
- Walter Rudin, Real and Complex Analysis, 2nd ed., McGraw-Hill, New York, 1974.

COURSE OUTLINE
MAY648 – CLASSICAL MECHANICS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE648**	**SEMESTER**	6th
COURSE TITLE	**Classical Mechanics**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		4	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://ecourse.uoi.gr/course/view.php?id=1559		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The course provides an introduction to theoretical physics, and aims to broaden the knowledge of Mechanics already gained even in secondary education, with the basic criterion being the mathematical formalism of physical problems. Therefore, the course introduces the basic concepts of Classical Mechanics and their application to particles, particle systems and continuous media. Upon completion of this course the students will be able to use advanced mathematics to describe natural phenomena and interpret mathematical results in physical terms. Also, students are expected to develop skills for formulating and solving physical problems.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology • Criticism and self-criticism • Production of free, creative and inductive thinking.

SYLLABUS

Review and connection via physical concepts with the basic tools: areas, mass and density, inertia, center of mass and moments. Review of basic types of differential equations and basic concepts of mechanics (space, time and material point). Newton's axioms and the notion of power. Linear motion, energy and angular momentum. Central forces, many-body systems. Lagrangian and Hamiltonian mechanics.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Yes
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	see table below

Activity	***Semester workload***
Lectures	52
Self study	104
Exercises	31.5
Course total	**187.5**

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final exam

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- T. W. B Kibble, F. H. Berkshire, Κλασική Μηχανική, Πανεπιστημιακές Εκδόσεις Κρήτης, 2012.
- Κ. Τσίγκανος, Εισαγωγή στη Θεωρητική Μηχανική, Εκδόσεις Σταμούλη, 2004.
- Ι. Χατζηδημητρίου, Θεωρητική Μηχανική (Τόμος Α'), Εκδόσεις Γιαχούδη, 2000.
- Π. Ιωάννου, Θ. Αποστολάτος, Θεωρητική Μηχανική, Πανεπιστήμιο Αθηνών, 2007.
- M. R. Spiegel, Θεωρητική Μηχανική, ΕΣΠΙ Εκδοτική, 1985.

COURSE OUTLINE
MAE501 – HISTORY OF MATHEMATICS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE501**	**SEMESTER**	5th
COURSE TITLE	**HISTORY OF MATHEMATICS**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	https://sites.google.com/site/apostolosthomamath/teaching/history-of-mathematics		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of the course is the Introduction to the History of Mathematics.
The course is about the history of Mathematical concepts that are covered in the curriculum of the Elementary school, High school and the first years of the University. There will be also presenations on topics that relate the development of Mathematics with the historical development of other Sciences.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work
- Working in an interdisciplinary environment
- Production of free, creative and inductive thinking

SYLLABUS

- Mathematics in Antiquity.
- Mathematics in Ancient Greece.
- Hellenistic Mathematics.
- Mathematics from 150 BC to the Renaissance in different civilizations.
- Topics on the History of Contemporary Mathematics.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Communication with students • Use of ICT in teaching
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each*	*Activity* / *Semester workload*: Lectures (13X3) – 39; Working independently – 38; Exercises-Homeworks – 73; Course total – **150**

Activity	*Semester workload*
Lectures (13X3)	39
Working independently	38
Exercises-Homeworks	73
Course total	**150**

learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Language of evaluation: Greek Written Examination, Oral Presentation, written assignments in Greek

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Katz, Victor, Ιστορία των Μαθηματικών, Ιδρυμα Τεχνολογίας και Ερευνας-Πανεπιστημιακές Εκδόσεις Κρήτης, 2013
- I. G. Basmakova, Ιστορία των Αρχαίων Ελληνικών Μαθηματικών, Παπασωτηρίου, 2012

COURSE OUTLINE
MAE511 – REAL ANALYSIS

GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="3">School of Science</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="3">Department of Mathematics</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="3">Undergraduate</td></tr>
<tr><td>COURSE CODE</td><td>MAE511</td><td>SEMESTER</td><td>5th</td></tr>
<tr><td>COURSE TITLE</td><td colspan="3">Real Analysis</td></tr>
<tr><td colspan="2">INDEPENDENT TEACHING ACTIVITIES
if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</td><td>WEEKLY TEACHING HOURS</td><td>CREDITS</td></tr>
<tr><td colspan="2">Presentations, exercises, lectures</td><td>3</td><td>6</td></tr>
<tr><td colspan="2">Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)</td><td></td><td></td></tr>
<tr><td>COURSE TYPE
general background, special background, specialised general knowledge, skills development</td><td colspan="3">Special background</td></tr>
<tr><td>PREREQUISITE COURSES:</td><td colspan="3"></td></tr>
<tr><td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td><td colspan="3">Greek</td></tr>
<tr><td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td><td colspan="3">Yes</td></tr>
<tr><td>COURSE WEBSITE (URL)</td><td colspan="3">http://www.math.uoi.gr/GR/studies/undergraduate/courses/perigr/MAE_511.pdf</td></tr>
</table>

LEARNING OUTCOMES

<table>
<tr><td>Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
• Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
• Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
• Guidelines for writing Learning Outcomes</td></tr>
<tr><td>The course aims in presenting topics concerning real valued functions defined on a metric space. Pointwise and uniform convergence of a sequence of functions are discussed as so as topics like Ascoli-Arzela theorem and Stone-Weirstrass theorem. Applications of the above are also given.</td></tr>
<tr><td>General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?</td></tr>
</table>

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

- Working independently
- Team work
- Working in an international environment
- Working in an interdisciplinary environment
- Production of new research ideas.

SYLLABUS

Function spaces on a metric space (X,d), pointwise and uniform convergence of sequence of functions, the space B(X) of real bounded functions on X-, the space C(X) of continuous functions on X – equicontinuous subsets of C(X), Ascoli-Arzela theorem and applications, Dini's theorem, Stone-Weierstrass theorem and applications, separable metric spaces, Lindelof's theorem on Euclidean spaces, the Cantor set, the Cantor function-applications.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT for the presentation and communication for submission of the exercises
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	(see table below)

Activity	***Semester workload***
Lectures	39
Home exercises	30
Independent study	81
Course total	**150**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examination at the end of the semester.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Charalambos D. Aliprantis, Owen Burkinshaw, Principles of Real Analysis, Academic Press.
- Michael O Searcoid, Metric Spaces, Springer Undergraduate Mathematics Series.

COURSE OUTLINE
MAE513 – ELEMENTS OF GENERAL TOPOLOGY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE513**	**SEMESTER**	5th
COURSE TITLE	**Elements of General Topology**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http:/www.math.uoi.gr/GR/studies/undergraduate /cousers/513.html		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of the course is to introduce the student to basic notions of General Topology and, in some way, to generalize already obtained knowledge on metric spaces. It is an optional course for students interested in having a background on pure mathematics. It is also attempted to broaden students horizon to mathematical structures which, even if they seem abstract, they have important applications in several branches of science.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these

appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*

- Analysis and synthesis of data and information
- Working independently
- Team work
- Working in an interdisciplinary environment
- Production of free, creative and inductive thinking
- Production of new research ideas

SYLLABUS

The notion of Topology. Topologies from metrics and non-metrizable topologies. Bases and subbases. Fundamental notions (open sets, closed sets, closure, interior, boundary, accumulation points). Neighborhood bases and systems. Convergence of sequences in topological spaces. Nets and convergence of nets. Continuity. Topologies from sequence of functions, product spaces. Spaces of 1st and 2nd countability. Separation (T1, T2, T3, T4 spaces). Compactness of topological spaces.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of special software (tex, mathematica, e.t.c.) for presentation of projects and exercises.
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	see table below

Activity	***Semester workload***
Lectures (6x3)	18
Seminars (7x3)	21
Individual study	78
Exrecises/projects	33
Course total	**150**

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Greek or English Public presentation Final written exam Criteria for evaluation are posted on course's site (E-course) at the beginning of each semester.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Π. Τσαμάτος, Τοπολογία, Εκδ. Τζιόλα, Θεσσαλονίκη 2025
- Χ. Καρυοφύλη και Χ. Κωνστανιλάκη, Τοπολογία I και II, Εκδόσεις Ζήτη, Θεσσαλονίκη 1990
- J. L. Kelley, General Topology, D. Van Nostrand Co. Inc., Toronto 1965
- J. Dugudji, Topology, Allyn and Bacon Inc., Boston 1978
- K. D. Joshi, Introduction to General Topology, Wiley Eastern Limited, New Delhi, 1986

COURSE OUTLINE
MAE525 – GROUP THEORY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE525**	**SEMESTER**	5th
COURSE TITLE	**Group Theory**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	*Special background, skills development.*		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek, English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	http://users.uoi.gr/nkechag/GroupsNotesLONG3.pdf		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes.

Familiarity with: group, abelian group, subgroup, normal subgroup, quotient group, direct product of groups, homomorphism, isomorphism, kernel of a homomorphism. Apply group theory to describe symmetry, describe the elements of symmetry group of the regular n-gon (the dihedral group D_{2n}). Compute with the symmetric group. Know how to show that a subset of a group is a subgroup or a normal subgroup. State and apply Lagrange's theorem. State and prove the isomorphism theorems. Sylow theorems. The classification of finite abelian groups. Normal series, central series, nilpotent groups. Applications in Geometry.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Production of new research ideas*
Adapting to new situations	*Project planning and management*
Decision-making	*Respect for difference and multiculturalism*
Working independently	*Respect for the natural environment*
Team work	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Working in an international environment	*Criticism and self-criticism*
Working in an interdisciplinary environment	*Production of free, creative and inductive thinking*
	Others

- Study particular characteristics of group theory in topology and geometry.
- Independent and team work.
- Working in an interdisciplinary.

SYLLABUS

- Basic properties in groups.
- Symmetries.
- Subgroups, Direct products, Cosets.
- Symmetric groups.
- Normal Subgroups, Quotient groups.
- Homomorphisms.
- Semidirect product.
- Classification of finite abelian groups.
- Sylow theorems.
- Normal series, Solvable groups. Central series, Nilpotent groups.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Communication with students
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art*	

Activity	*Semester workload*
Lectures (13X3)	39
Working independently	78
Exercises-Homeworks	33
Course total	**150**

workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written Examination, Oral Presentation, written assignments in Greek (in case of Erasmus students in English) which includes resolving application problems.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- An Introduction to the Theory of Groups (Graduate Texts in Mathematics) 4th Edition by Joseph Rotman.
- Θεωρία ομάδων, Μιχάλης. Α. Γεωργιακόδης - Παναγιώτης. Ν. Γεωργιάδης
- M.A. Armstrong: «Ομάδες και Συμμετρία» (Κεφ. 1-24), Εκδόσεις «Leaderbooks».

COURSE OUTLINE
MAE526 – GROEBNER BASES

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE526**	**SEMESTER**	5th
COURSE TITLE	**Groebner Bases**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://sites.google.com/site/apostolosthomamath/teaching/		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area • Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B • Guidelines for writing Learning Outcomes.
The students will acquire with the successful completion of the course i) the skills to apply polynomial division ii) the skills to compute Groebner bases iii) the skills to apply Groebner bases techniques to problems coming from elimination theory, Algebraic Geometry, filed extensions, Graph Theory and Integer programming.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*

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

The course aim is for the student to acquire the ability in analysis and synthesis of knowledge in Computational Algebra and produces free, creative and inductive thinking.

SYLLABUS

Polynomial rings. Hilbert;s basis Theorem. Noetherian rings. Monomial orders. Division Alghorithm. Groebner bases. S-polynomials and Buchberger;s alghorithm.
Irreducible and universal Groebner bases. Nullstellensatz Theorem. Applications of Groebner: bases in elimination, Algebraic Geometry, field extensions, Graph Theory and Integer Programming.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	see table below

Activity	*Semester workload*
Lectures (13X3)	39
Working independently	78
Exercises-Homeworks	33
Course total	**150**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English) which includes resolving application problems.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Μ. Μαλιάκας, Εισαγωγή στη Μεταθετική Άλγεβρα, 2008, "Σοφία" Ανώνυμη Εκδοτική & Εμπορική Εταιρεία, ISBN: 978-960-88637-4-3

COURSE OUTLINE
MAE531- THEORY OF PROBABILITY AND STATISTICS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE531**	**SEMESTER**	5th
COURSE TITLE	**Theory of Probability and Statistics**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English, reading Course)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
Extension and generalization of concepts taught in MAF331 and MAF431. Creation of a suitable base for deepening the scope of Statistical Science. At the end of the course the student should be able to: a) Model procedures and situations that occur in everyday reality or in other scientific areas in the Theory of Probability. b) Understand the basic limit theorems of Probability Theory (laws of large numbers, central limit theorem) and use them for approximating probability calculations. c) Find the distribution of a function of random variables. d) Make basic calculations of probability, averages, dispersions, etc., in problems involving randomness with more than one random variable.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*

- Working independently
- Decision-making
- Production of free, creative and inductive thinking
- Criticism and self-criticism

SYLLABUS

Random vectors-Multivariate distribution function-Joint probability- Joint probability density function. Marginal distributions. Conditional distributions. Special bivariate and multivariate distributions (multinomial, bivariate and multivariate normal etc). Expectation, Variance-Covariance matrix. Moments and Moment generating function of random vector. Distribution of a function of random variables. Order Statistics. Convergence of random variables. Sampling distributions.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	see table below

Activity	***Semester workload***
Lectures (13 X 3h)	39
Working independently	78
Exercises-Homework	33
Course total	***150***

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English).

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

Texts in English

- Mood, A. M., Graybill, F. A. and Boes, D. C. (1974). Introduction to the Theory of Statistics. 3d ed. ISBN-13 9780070854659. McGraw-Hill. New York.

Texts in Greek

- Παπαϊωάννου, Τ. (1997). Θεωρία Πιθανοτήτων και Στατιστικής. ISBN 960-351-130- 7. Εκδόσεις Σταμούλη ΑΕ.
- Κούτρας Μάρκος Β.(2012). Εισαγωγή στη Θεωρία Πιθανοτήτων και Εφαρμογές. ISBN 978-960-351-903-4. Εκδόσεις Σταμούλη ΑΕ.

COURSE OUTLINE
MAE532 – STOCHASTIC PROCESSES

GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="3">School of Science</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="3">Department of Mathematics</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="3">Undergraduate</td></tr>
<tr><td>COURSE CODE</td><td>MAE532</td><td>SEMESTER</td><td>5th</td></tr>
<tr><td>COURSE TITLE</td><td colspan="3">Stochastic Processes</td></tr>
<tr><td colspan="2">INDEPENDENT TEACHING ACTIVITIES
if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</td><td>WEEKLY TEACHING HOURS</td><td>CREDITS</td></tr>
<tr><td colspan="2">Lectures</td><td>3</td><td>6</td></tr>
<tr><td colspan="2">Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)</td><td></td><td></td></tr>
<tr><td>COURSE TYPE
general background, special background, specialised general knowledge, skills development</td><td colspan="3">Special Background</td></tr>
<tr><td>PREREQUISITE COURSES:</td><td colspan="3"></td></tr>
<tr><td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td><td colspan="3">Greek</td></tr>
<tr><td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td><td colspan="3">Yes (in English, reading Course)</td></tr>
<tr><td>COURSE WEBSITE (URL)</td><td colspan="3">http://users.uoi.gr/abatsidis/532.html</td></tr>
</table>

LEARNING OUTCOMES

<table>
<tr><td>Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
• Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
• Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
• Guidelines for writing Learning Outcomes</td></tr>
<tr><td>The term "stochastic" is used to describe phenomena in which some randomness inherent. A stochastic process is a probabilistic model that describes the behaviour of a system that randomly evolves over time. Observing the system at discrete points in time (for instance at the end of each day or at the end of a time period, etc.) one gets a discrete time stochastic process. Observing the system continuously through time one gets a continuous time stochastic process. Objectives of the course are:
a) Understanding the behaviour of a real system and based on its study to derive reliable results,
b) a careful analysis of the model and the calculation of the results. A variety of classes of stochastic processes such as, the random walk, the Markov chains etc is used.</td></tr>
</table>

The student should be able to understand the meaning of the stochastic process, use the Markov processes for modelling systems and become familiar with their application, and be able to make various calculations and appropriate conclusions when the stochastic process describes a specific applied problem.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Working independently • Decision-making • Production of free, creative and inductive thinking • Criticism and self-criticism

SYLLABUS

Random Walk: Simple random walk, absorbing barriers, reflecting barriers. Markov Chains: General definitions, classification of states, limit theorems, irreducible chains. Markov Processes: The birth-death process. Applications.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in communication with students
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art*	

Activity	***Semester workload***
Lectures	39
Working independently	78
Exercises-Homework	33
Course total	**150**

workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English) which concentrates on the solution of problems which are motivated by the main themes of the course.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Books in English

- Lawler. Introduction to Stochastic Processes
- Ross. Introduction to probability models (Chapters 4, 6, 7)

Books in Greek:

- Χρήστος Λάγκαρης. Θεωρία Στοχαστικών διαδικασιών. Πανεπιστημιακό Τυπογραφείο Ιωαννίνων.
- Στοχαστικές Ανελίξεις , Κάκουλλος Θεόφιλος
- Στοχαστικές ανελίξεις, Δάρας Τρύφων Ι., Σύψας Παναγιώτης Θ.
- Στοχαστικές μέθοδοι στις επιχειρησιακές έρευνες, Βασιλείου Παναγιώτης - Χρήστος Μαθήματα στοχαστικών διαδικασιών Τ.Α., Αρτίκης Θεόδωρος Π.

COURSE OUTLINE
MAE541 – DATA STRUCTURES

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE541**	**SEMESTER**	5th
COURSE TITLE	**Data Structures**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures and laboratory exercises		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course is an introduction to basic data structures such as strings, arrays, lists, stacks, queues, trees, graphs. It studies properties and implementation issues as well as basic properties on the data structures and their complexity. It also examines basic applications of the above data structures. The main purpose is the design and use of appropriate data structures for storing and retrieving the data of a problem in order for a most efficient processing during the problem solving process.
After completing the course the student:
- Has an understanding of basic data structures and the different ways they can be implemented using a programming language.
- Can choose appropriate data structures for efficiently storing the data of a problem and their use by an algorithms for solving the problem.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Working independently • Problem data analysis • Can use data structures for solving problems in other scientific areas or in the workplace.

SYLLABUS

- Elements Of Analysis Of Algorithms
- Abstract Data Types
- Strings
- Arrays
- Algorithms for Searching, Sorting, Selection
- Lists (Single Linked Lists, Doubly Linked Lists, Circular Lists, Generalised Lists)
- Stacks
- Queues, DeQueues, Priority Queues
- Trees (General Trees, Binary Trees, Binary Search Trees, Threaded Trees)
- Heaps
- AVL-Trees, 2-3 Trees, 2-3-4 Trees, B Trees
- Directed Graphs, Undirected Graphs
- Set Manipulation
- Hashing
- Dynamic Memory Management

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Yes
TEACHING METHODS *The manner and methods of teaching are described in detail.*	

Activity	***Semester workload***
Lectures	39
Self study	78

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	<table><tr><td>Exercises</td><td>33</td></tr><tr><td></td><td></td></tr><tr><td>Course total</td><td>**150**</td></tr></table>
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written final exam (70%) comprised of: • questions about the theory of data structures • Questions crisis in the form of exercises that require the use of data structures • Exercises testing the understanding of the implementation issues and use of data structures Laboratory exercises / midterm (30%)

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Data structures, algorithms and applications using c ++, Sahnii Sartaj, Publicer A. Tziola (Greek translation)
- Algorithms in C ++, parts 1-4: fundamental concepts, data structures, sorting, searching, Robert Sedgewick, Prentice Hall (Greek translation)
- Algorithms in C, parts 1-4: fundamental concepts, data structures, sorting, searching, Robert Sedgewick, Prentice Hall (Greek translation)
- Data Structures with C, Nicholas Misirlis (Greek)
- Data Structures, Bozanis Panagiotis, Publicer A. Tziola (Greek)
- Michael T. Goodrich, Roberto Tamassia, and David M. Mount, Data Structures and Algorithms in C ++, John Wiley & Sons
- Michael Goodrich, Roberto Tamassia, Data Structures and Algorithms in Java, Publicer DIAYLOS
- Cormen, Leiserson and Rivest, Introduction to Algorithms, MIT Press, 1990. (there is also a translation from the University of Crete)

- Mark Allen Weiss, Data Structures & Algorithm Analysis in Java, Addison-Wesley
- Clifford A. Shaffer, Data Structures and Algorithm Analysis, ebook, http://people.cs.vt.edu/shaffer/Book/

- Website: opendatastructures.org

COURSE OUTLINE
MAE542 – INTRODUCTION TO COMPUTATIONAL COMPLEXITY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE542**	**SEMESTER**	5th
COURSE TITLE	**Introduction to Computational Complexity**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
lectures, exercises, tutorials		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

This course aims at introducing to students the concepts of time and space complexities for solving difficult problems.
After successfully passing this course the students will be able to:
- Understand complexity classes
- Push further techniques for solving difficult problems
- Understand difficult problems by using reductions.

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work
- Project planning and management

SYLLABUS

- NP and Computational Intractibility
- The class of PSPACE
- Extending the limits of tractability
- Approximation Algorithms
- Local search.
- Randomized algorithms

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of projector and interactive board during lectures.
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each*	see table below

Activity	*Semester workload*
Lectures	39
Working independently	78
Exercises – Homework	33
Course total	**150**

learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Final written examination (70%) • Exercises / Homework (30%)

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- [Pa98] "Computational Complexity", Christos Papadimitriou.
- [GJ77] "Computers and Intractability", M. R. Garey and D. S. Johnson.
- [KT] J. Kleinberg and E. Tardos, Σχεδιασμός Αλγορίθμων, ελληνική έκδοση, Εκδόσεις Κλειδάριθμος, 2008
- [CLRS] T. Cormen, C. Leiserson, R. Rivest, and C. Stein, Εισαγωγή στους Αλγορίθμους, ελληνική έκδοση, Πανεπιστημιακές Εκδόσεις Κρήτης, 2012.

COURSE OUTLINE
MAE543 – APPLIED TENSOR ANALYSIS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE543**	**SEMESTER**	5th
COURSE TITLE	**Applied Tensor Analysis**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course is an introduction to the concepts of Tensor Analysis. The objectives of the course are:
- Development of the theoretical background in matters relating to Tensor Analysis.
- Ability of the student to apply the basic concepts of Tensor Analysis.
- Upon completion of this course the student will be able to solve with analytical methods simple problems of Tensor Analysis and deepen further understanding of such methods.

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these

appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims to enable the undergraduate students to develop basic knowledge of Applied Tensor Analysis and in general of Applied Mathematics. The student will be able to cope with problems of Applied Mathematics giving the opportunity to work in an international multidisciplinary environment.	

SYLLABUS

The tensor concept, Invariance of tensor equations, Curvilinear coordinates, Tensors in generalized curvilinear coordinates, Gauss, Green and Stokes theorems, Scalar and vector fields, Nabla operator and differential operators, Covariant differentiation, Integral theorems, Applications to Fluid Dynamics.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	In class
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	see table below

Activity	***Semester workload***
Lectures	39
Study of theory	78
Home exercises	33
Total	**150**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Weekly assignments • Final project • Written examination at the end of the semester

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- A. I. Borisenko and I. E. Taparov, Vector and Tensor Analysis, Edition: 2/2017, Editor: G. C. FOYNTAS (in Greek).
- H. Lass, Vector and Tensor Analysis, Edition: 2/2017, Editor: G. C. FOYNTAS (in Greek).

COURSE OUTLINE
MAE544 – LOGIC PROGRAMMING

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE544**	**SEMESTER**	5th
COURSE TITLE	**Logic Programming**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The goal of this course is the deeper understanding of PROLOG. During the course a detailed examination of the following topics are done:

- Procedural and Declarative Programming
- Logic Programming a version of Declarative Programming
- The programming language PROLOG (PROLOG programs syntax, Lists, Operators, Arithmetic, Backtracking control, The negation in PROLOG, Recursive predicates, Data Structure manipulation, PROLOG implementation to searching problems, symbolic processing, natural language understanding and metaprogramming)

- Logic Programming Theory
- Logic Programming under restrictions
- Logic Programming systems implementation techniques
- Parallel Logic Programming
- Logic Programming for knowledge representation

After completing the course the student can handle:
- programming in PROLOG
- solving exercises in PROLOG
- tracking applications in PROLOG

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Programming in PROLOG
- Implement PROLOG to Mathematics, Natural Language, Expert Systems, e.t.c.
- Implementation- Consolidation.

SYLLABUS

- Introductory concepts of Automata , Computability and Complexity as well as basic definitions, basic theorems and inductive proofs
- Finite State Machines and Languages, Finite Automata (Deterministic FA, Nondeterministic FA, FA with Epsilon-Transitions) and their applications, Regular Expressions and Languages, derivation trees. Removing Nondeterminism . Equivalence NFA and NFA with ε-moves. Minimization of DFA, Pumping Lemma
- FA and Grammars. Grammars of Chomsky Hierarchy. Regular Sets (RS). Properties of Regular Languages. RS and FA. Finding a correspondence Regular Expression of a FA. Abilities and disabilities of FA.
- Context-Free Grammars and Languages, Pushdown Automata (Deterministic PDA, Acceptance by Final State, Acceptance by Empty Stack) , Properties of Context-Free Languages. Correspondence PDA and Context-Free Languages.
- Introduction of Turing Machines. Standard TM, useful techniques for TM constructions. Modification of TM. TM as procedure.
- Unsolvability. The Church-Turing Thesis. The Universal TM. The Halting Problem for TM. Computational Complexity. NP-complete problems.

TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Yes, Use of Natural Language and Mathematical Problems Processing Laboratory</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td>Lectures</td><td>39</td></tr><tr><td>Self study</td><td>78</td></tr><tr><td>Exercises</td><td>33</td></tr><tr><td></td><td></td></tr><tr><td>Course total</td><td>150</td></tr></table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>• Final test</td></tr>
</table>

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Π. Σταματόπουλος, "Λογικός και Συναρτησιακός Προγραμματισμός", Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών, 2016. http://hdl.handle.net/11419/3587 (με διορθωμένα παροράματα εδώ)
- Η. Σακελλαρίου, Ν. Βασιλειάδης, Π. Κεφαλάς, Δ. Σταμάτης, "Τεχνικές Λογικού Προγραμματισμού", Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών, 2016. http://hdl.handle.net/11419/777
- I. Bratko, "Prolog Programming for Artificial Intelligence", Third Edition, Addison-Wesley, 2000.
- L. Sterling, E. Shapiro, "The Art of Prolog", The MIT Press, 1994.
- J. W. Lloyd, "Foundations of Logic Programming", Springer Verlag, 1993

COURSE OUTLINE
MAE545 – NUMERICAL LINEAR ALGEBRA

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE545**	**SEMESTER**	5th
COURSE TITLE	**Numerical Linear Algebra**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

After successful end of this course, students will be able to:

- understand the basic theory of matrices,
- be aware of the taught methods to solve linear systems,
- be aware of the taught methods for computing eigenvalues and eigenvectors,
- choose the appropriate method by taking into account the stability and speed of the algorithm as well as the conditioning of the system.
- implement the above methods with programs on the computer.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these

appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Criticism and self-criticism
- Production of free, creative and inductive thinking

SYLLABUS

Introduction to Matrix theory. Conditioning of Linear Systems, Stability of the methods. Direct methods: Gauss Elimination Method, LU Factorization, Cholesky Factorization. Iterative methods: Jacobi, Gauss-Seidel, Extrapolation technique, SOR method. Minimization methods for solving linear systems: steepest descent method, Conjugate Gradient method. The linear least squares problem: System of Canonical Equations, QR method. Computation of eigenvalues and eigenvectors: Power Method, Inverse Power Method.

TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>In the class</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td></td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Study and analysis of bibliografy</td><td>78</td></tr>
<tr><td>Exercises-Homeworks</td><td>33</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
</table>

hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examination

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- "Numerical Linear Algebra". Dougalis V., Noutsos D., Hadjidimos A., University of Ioannina.

COURSE OUTLINE
MAE546 - BIOMATHEMATICS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE546**	**SEMESTER**	5th
COURSE TITLE	Biomathematics		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course is an introduction to the concepts of Biomathematics. The objectives of the course are:

- Development of the theoretical background in matters relating to biomathematics.
- Ability of the student to apply the basic concepts of biomathematics.
- Upon completion of this course the student will be able to solve with analytical and numerical methods simple problems of biomathematics and deepen further understanding of such methods.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data *Project planning and management*

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

The course aims to enable the undergraduate students to develop basic knowledge of Biomathematics and in general of Applied Mathematics. The student will be able to cope with problems of Biomathematics giving the opportunity to work in an international multidisciplinary environment.

SYLLABUS

Short introduction of Algebra, Analysis and Differential Equations, Differential equations of biofluids motion, Applications of mathematical modeling of biofluids in the human body and in the arterial system, Analytical and numerical techniques for solving the differential equations describing biofluids flows,
Algbraic statistics for Computational Biology: Algebraic varieties and Groebner bases, Toric ideals and varieties, Linear and toric models, Markov bases, Markov bases for hierarchical models, Contigency tables, Phylogenetic Models.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	In class
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	<table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td>Lectures</td><td>39</td></tr><tr><td>Study of theory</td><td>78</td></tr><tr><td>Home exercises</td><td>33</td></tr><tr><td></td><td></td></tr><tr><td>Total</td><td>150</td></tr></table>

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Weekly assignments • Final project • Written examination at the end of the semester

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Applied Fluid Mechanics, D. G. Papanikas, 4th Edition, 2010, Editor: F. Papanikas & Co, G. P. (in Greek)
- Computational Fluid Mechanics, J. Soulis, 1st Edition, 2008, Editor: X. N. Aivazis (in Greek)
- Algebraic Statistics for Computational Biology, L. Pachter, B. Sturmfels, 2005, Editor: Cambridge University Press
- Cardiovascular Mathematics, Modeling and simulation of the circulatory system, Formaggia L., Quarteroni A., Veneziani A., 2009, Editor: Springer

COURSE OUTLINE
MAE613 – INTEGRAL EQUATIONS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE613**	**SEMESTER**	6th
COURSE TITLE	**Integral Equations**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	Through the platform “E-course” of the University of Ioannina		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area • Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B • Guidelines for writing Learning Outcomes
The course aims to an introduction to the area of Integral Equations. Students are expected to obtain basic knowledge on standard types of integral equations, learn how to solve certain linear integral equations, also study existence and uniqueness of solutions by the use of fixed point theorems.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment*

Adapting to new situations *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment*	*Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*

- Working independently
- Team work
- Production of free, creative and inductive thinking
- Production of analytic and synthetic thinking

SYLLABUS

An introduction with historical notes. Classification of Integral Equations. Problems leading to integral equations. Laplace transformations and their use to solving integral equations. Other integral transformations. Volterra integral equations: Neumann series, successive approximations, Laplace transformation and the convolution kernel. Fredholm integral equations: Symmetric kernels, separated kernels, Fredholm Alternative, classical Fredholm theory. Green functions for second order boundary value problems. Existence and uniqueness of solutions: Banach spaces, contractions and applications to integral equations. Existence of solutions by Schauder's theorem.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures. Presentations in class.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of the platform "E-course" of the University of Ioannina
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	(see workload table below)
STUDENT PERFORMANCE EVALUATION	

Activity	*Semester workload*
Lectures/Presentations	39
Assignments	33
Individual study	78
Course total	**150**

Description of the evaluation procedure *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Students choose evaluation by one or both of the following: • Class presentation – Essays – Assingments • Final Written Examination In case that a student participates to both, the final grade is the maximum of the two grades. Evaluation criteria and all steps of the evaluation procedure are accessible to students through the platform "E-course" of the University of Ioannina.

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Σ. Ντούγια, Ολοκληρωτικές Εξισώσεις
- C. Corduneanu, Principles of Differential and Integral Equations

COURSE OUTLINE
MAE614 – DIFFERENTIAL EQUATIONS I

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE614**	**SEMESTER**	6th
COURSE TITLE	**Differential Equations I**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http:/www.math.uoi.gr/GR/studies/undergraduate /cousers/614.html		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The course is an introduction to the qualitative theory of ordinary differential equations. An attempt is made so that the student is introduced to the notions of existence, uniqueness, and extension of solutions of differential equations and initial value problems. Students begin to visualize (on the place) the behaviour of solutions to ode's and or their perturbations. Elements of the general theory of dynamical systems are also presented. To introduce the student to basic notions of General Topology and, in some way, to generalize already obtained knowledge on metric spaces. It is an optional course for students interested in having a background on pure mathematics. It is also attempted to broaden students horizon to mathematical

structures which, even if they seem abstract, they have important applications in several branches of science.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Analysis and synthesis of data and information
- Working independently
- Team work
- Working in an interdisciplinary environment
- Production of free, creative and inductive thinking
- Production of new research ideas

SYLLABUS

Ordinary differential equations: Existence, uniqueness and expansion of initial value problems. Theory of linear systems of ode,s. Homogenous and non-homogenous linear systems. Homogenous systems with constant coefficients. Stability of linear systems. Classification of 1^{st} order 2-dimensional differential equations. Introduction to the theory of dynamical systems.

TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of special software (tex, mathematica, e.t.c.) for presentation of projects and exercises.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (7x3)</td><td>21</td></tr>
<tr><td>Seminars (6x3)</td><td>18</td></tr>
<tr><td>Individual study</td><td>78</td></tr>
<tr><td>Exrecises/projects</td><td>33</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table></td></tr>
</table>

visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Greek or English Public presentation Final written exam Criteria for evaluation are posted on course's site (E-course) at the beginning of each semester

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Γ. Καρακώστας, Διαφορικές Εξισώσεις Ι, Πανεπιστήμιο Ιωαννίνων 2014
- Δημητρίου Σούρλα, Συνήθεις Διαφορικές Εξισώσεις, Εκδόσεις Συμμετρία, Αθήνα 2010
- Julien Arino, Fundamental Theory of Ordinary Differential Equations, Lecture Notes, Dept. of Mathematics, University of Manitoba, 2006
- H. Logemann and E. P. Ryan, Ordinary Differential Equations, Springer-Verlag London 2014

COURSE OUTLINE
MAE615 – TOPICS IN REAL ANALYSIS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE615**	**SEMESTER**	6th
COURSE TITLE	**Topics in Real Analysis**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The plan of the course is the achievement by the undergraduate student of the introductory background in the theory of metric spaces.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
	Respect for the natural environment
	Showing social, professional and ethical responsibility and

Decision-making *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The objective of the course is the undergraduate student's ability achievement in analysis and synthesis of the basic background in Real Analysis.	

SYLLABUS

Baire spaces, the theorem of Cantor, characterization of complete metric spaces, compact metric spaces, Lebesgue's lemma, uniform continuous functions and extensions of them, completetion of a metric space and uniqueness up to isometry, oscillation of a function, continuity sets of a function which is the pointwise limit of a sequence of continuous functions, uniform convergence of a sequence of functions and related topics, Dini's theorem.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	see workload table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.*	Written examination at the end of the semester.

Activity	*Semester workload*
Lectures	39
Independent study	78
Exercises solutions	33
Course total	**150**

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Charalambos D. Aliprantis, Owen Burkinshaw, Principles of Real Analysis, Academic Press.

COURSE OUTLINE
MAE616 – MEASURE THEORY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE616**	**SEMESTER**	6th
COURSE TITLE	**Measure Theory**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background		
PREREQUISITE COURSES	None (from the typical point of view) In order to be able to follow this course, the knowledge from the following courses are required Infinetisimal Calculus I, Introduction to Topology		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (exams in English are provided for foreign students)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area • Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B • Guidelines for writing Learning Outcomes
After completing this course the students will • Have knowledge of the basic properties of σ-algebras, of measures and especially of Lebesgue measure on the set R of real number and on the Euclidean space R^k. • Know the basic properties of measurable functions, the definition of Lebesgue integral in a random measure space. • Be able to apply the basic theorems concerning Lebesgue intergral (Monotone Convergernce Theorem, Dominated Convergence Theorem).

• Understand the difference between Riemann integral and Lebesgue integral on R.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
The course promotes inductive and creative thinking and aims to provide the student with the theoretical background and skills to use measure theory and integration.

SYLLABUS

Algebras, σ-algebras, measures, outer measures, Caratheodory's Theorem (concerning the construction of a measure from an outer measure). Lebesgue measure, definition and properties. Measurable functions. Lebesgue integral, Lebesgue's Monotone Convergernce Theorem, Lebesgue's Dominated Convergence Theorem. Comparison between Riemann integral and Lebesgue integral for functions defined on closed bounded integrals of the set of reals.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Teaching on the blackboard by the teacher.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Communication with the teacher by electronic means (i.e. e-mail).
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures</td><td>39</td></tr><tr><td>Personal study</td><td>78</td></tr><tr><td>Solving exercises</td><td>33</td></tr><tr><td></td><td></td></tr><tr><td>Course total</td><td>**150**</td></tr></table>

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Exams in the end of the semester (mandatory), potential intermediate exams (optional), assignments of exercises during the semester (optional).

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Θεωρία Μέτρου, Γ. Κουμουλλής, Σ. Νεγρεπόντης, Εκδόσεις Συμμετρία (κωδικός στο σύστημα Εύδοξος: 45284).
- Measure Theory, Donald Cohn, Birkhauser.

COURSE OUTLINE
MAE622 – DIFFERENTIABLE MANIFOLDS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE622**	**SEMESTER**	6th
COURSE TITLE	**Differentiable Manifolds**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek, English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes.*
In this lecture, the fundamental concept of a differentiable manifold will be developed. In particular, this lecture is a basic prerequisite for the upcoming class of Riemannian geometry. After a quick review of basic facts from general topology we will introduce the notions of a smooth manifold, tangent bundle, vector field, submanifold, connection, geodesic curve, parallel transport and Riemannian metric. On the completion of this course we expect that the students fully understand these important concepts and the main theorems that will be presented in the lectures.

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Working independently • Decision-making • Production of free, creative and inductive thinking • Criticism and self-criticism

SYLLABUS

Review of basic facts from general topology, smooth manifolds, tangent bundle, vector fields, immersions and embeddings, Lie bracket, Frobenius' theorem, Whitney's embedding theorem, connections and parallel transport, Riemannian metrics.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well*	see table below

Activity	***Semester workload***
Lectures (13X3)	39
Working independently	78
Exercises-Homeworks	33
Course total	**150**

as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Weekly exercises and homeworks, presentations, final written exam in Greek (in case of Erasmus students in English) which includes resolving application problems.

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- M. do Carmo, *Riemannian Geometry*, Birkhaüser Boston, Inc., Boston, MA, 1992.
- V. Guillemin & A. Pollack, *Differentiable Topology*, Prentice-Hall, Inc, Englewood Cliffs, 1974.
- J. Lee, *Introduction to Smooth Manifolds*, Graduate Texts in Mathematics, 218, 2013.
- J. Milnor, *Topology From the Differentiable Viewpoint*, Princeton University Press, NJ, 1997.
- L. Tu, *An Introduction to Manifolds*, Universitext. Springer, New York, 2011.
- Δ. Κουτρουφιώτης, *Διαφορική Γεωμετρία*, Πανεπιστήμιο Ιωαννίνων, 1994.

COURSE OUTLINE
MAE623 – GEOMETRY OF TRANSFORMATIONS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE623**	**SEMESTER**	6th
COURSE TITLE	**Geometry of Transformations**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES	Linear Algebra, Analytic Geometry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course can be viewed as a continuation of Analytic Geometry. The aim is to study geometric transformations of the plane or space. The classification of isometries is provided. Further applications are given, as well the classification of second degree surfaces. Moreover, algebraic curves are studied.

Upon completion of the course, the student should be familiar with notions of geometry and geometric transformations that are used in other courses like Calculus of several variables.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these

appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*

- Work autonomously
- Work in teams
- Develop critical thinking skills.

SYLLABUS

Geometric transformations of the plane and space. Isometries, applications. Classification of second degree surfaces. Algebraic curves.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Direct
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	see table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-*	Written final examination.

Activity	***Semester workload***
Lectures	39
Autonomous study	111
Course total	**150**

answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Thomas F. Banchoff και John Wermer, Η Γραμμική Άλγεβρα μέσω Γεωμετρίας, Εκδόσεις Leader Books, Σειρά Πανεπιστημιακά Μαθηματικά Κείμενα, Αθήνα, 2009

COURSE OUTLINE
MAE624 – ELEMENTARY GLOBAL DIFFERENTIAL GEOMETRY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE624**	**SEMESTER**	6th
COURSE TITLE	**Elementary Global Differential Geometry**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area • Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B • Guidelines for writing Learning Outcomes
It is an introductory course on global differential geometry. The aim is to study global geometric properties of regular plane curves and regular surfaces. The study requires tools from Linear Algebra, Calculus of several variables, Topology and elementary differential geometry. On completion of the course the student should be familiar with the interplay between local and global properties of curves and surfaces.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*

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

- Work autonomously
- Work in teams
- Develop critical thinking skills

SYLLABUS

Convex curves, Hopf's Umlaufsatz, Four vertex theorem, isoperimetric inequality.
Surfaces, vector fields, covariant derivative, parallel transport, geodesic curvature, geodesics, exponential map, surfaces of constant Gaussian curvature, Gauss Bonnet Theorem, Liebmann Theorem.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Direct
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	(see table below)

Activity	***Semester workload***
Lectures	39
Autonomous study	111
Course total	**150**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written final examination

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Δ. Κουτρουφιώτης, Στοιχειώδης Διαφορική Γεωμετρία, Εκδόσεις Leader Books, 2006
- Barrett O' Neil, Στοιχειώδης Διαφορική Γεωμετρία, Πανεπιστημιακές Εκδόσεις Κρήτης, 2002
- Andrew Pressley, Στοιχειώδης Διαφορική Γεωμετρία, Πανεπιστημιακές Εκδόσεις Κρήτης, 2011
- Manfredo do Carmo, Differential Geometry of Curves and Surfaces, Prentice-Hall, 1976

COURSE OUTLINE
MAE627 – ALGEBRAIC CURVES

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE627**	**SEMESTER**	6th
COURSE TITLE	**Algebraic Curves**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	https://sites.google.com/site/apostolosthomamath/teaching/		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes.

The students will acquire with the successful completion of the course the basic theory of Algebraic curves and the ability to solve problems on Algebraic curves.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
	Respect for difference and multiculturalism
	Respect for the natural environment
Adapting to new situations	*Showing social, professional and ethical responsibility and*

Decision-making *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*

The course aim is for the student to acquire the ability in analysis and synthesis of knowledge in algebraic curves and produces free, creative and inductive thinking.

SYLLABUS

Affine plane, polynomial rings, unique Factorization Domains, resultants, Rational curves and Applications, Projective space, tangents, singular points, asymptotes. Intersection multiplicity, Bezout's Theorem, Linear Systems. Pascal's Theorem. Nine points Theorem. Inflection points. Elliptic Curves.

TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Classroom (face-to-face)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td></td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (13X3)</td><td>39</td></tr>
<tr><td>Working independently</td><td>78</td></tr>
<tr><td>Exercises-Homeworks</td><td>33</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure.
Language of evaluation, methods of evaluation, summative or</td><td>Final written exam in Greek (in case of Erasmus students in English) which includes resolving application problems.</td></tr>
</table>

conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- *Δ. Πουλάκης, Εισαγωγή στη γεωμετρία των αλγεβρικών καμπυλών, Εκδόσεις Ζήτη,*ISBN 960-456-013-1, ISBN-13 978-960-456-013-4

COURSE OUTLINE
MAE628 – MODULES, RINGS AND APPLICATIONS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE628**	**SEMESTER**	6th
COURSE TITLE	**Modules, Rings and Applications**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area • Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B • Guidelines for writing Learning Outcomes.
The principal aim of the course is to introduce the students to the main tools and methods of the theory of modules and rings. At the end of the course we expect the student to have understood the definitions and basic theorems which are discussed in the course, to have understood how they are applied in discrete examples, to be able to apply the material in order to extract new elementary conclusions, and finally to perform some (no so obvious) calculations.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*

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

The contact of the undergraduate student with the ideas and concepts of the theory of modules and rings, (a) promotes the creative, analytical and deductive thinking and the ability to work independently, (b) improves his critical thinking and his ability to apply abstract knowledge in various field.

SYLLABUS

- Elementary Ring Theory.
- Euclidean Domains, Principal Ideal Domains and Unique Factorization Domains.
- Module Theory.
- Modules over polynomial rings.
- Finitely generated and free modules.
- Modules over Principal Ideal Domains.
- Decomposition Theorems.
- Applications to Linear Algebra and Abelian groups.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures (13X3)</td><td>39</td></tr><tr><td>Working independently</td><td>78</td></tr><tr><td>Exercises-Homeworks</td><td>33</td></tr><tr><td></td><td></td></tr><tr><td>Course total</td><td>**150**</td></tr></table>

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English) which includes resolving application problems.

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Μ. Μαλιάκας – Ο. Ταλέλλη: «Πρότυπα πάνω σε Περιοχές Κυρίων Ιδεωδών και Εφαρμογές», Εκδόσεις Σοφία.
- Μ. Μαλιάκας: «Εισαγωγή στη Μεταθετική Άλγεβρα», Εκδόσεις Σοφία.
- N. Jacobson: “Basic Algebra I”, Dover Publications (1985).
- S. Lang: «Άλγεβρα», Εκδόσεις Πολιτεία (2010).

COURSE OUTLINE
MAE631- LINEAR PROGRAMMING

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE631**	**SEMESTER**	6th
COURSE TITLE	**Linear Programming**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course learning outcomes are: the introduction of the students to linear programming formulation, the comprehension of the mathematical properties of linear programming problems, the understanding of the theory underlying the simplex algorithm, the understanding of the dual theory and its interpretation, the use of LINDO software package to solve linear programming problems.
Upon successful completion of the course the student will be able to:

- to model linear programming problems.
- to solve linear programming problems with the Simplex method.
- to apply the appropriate modifications of Simplex method when it is necessary.
- to validate and interpret the results obtained when linear programming problems are solved using LINDO software.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Working independently • Decision-making • Adapting to new situations • Production of free, creative and inductive thinking • Synthesis of data and information, with the use of the necessary technology.

SYLLABUS

- Linear programming problems formulation
- Graphical solution
- The Simplex Method
- The Big M method
- The Two-Phase Simplex Method
- Dual theory
- Sensitivity analysis
- Transportation problem
- Assignment problem

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Lindo Software, Email, class web
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	(see table below)

Activity	***Semester workload***
Lectures	39
Independent study	78
Fieldwork (3-4 set of homework)	33
Course total	**150**

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	LANGUAGE OF EVALUATION: Greek METHODS OF EVALUATION: Final exam (100%)

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- ΒΑΣΙΛΕΙΟΥ Π. και ΤΣΑΝΤΑΣ Ν., Εισαγωγή στην επιχειρησιακή έρευνα, Εκδόσεις ΖΗΤΗ 2000.
- ΦΑΚΙΝΟΥ Δ. και ΟΙΚΟΝΟΜΟΥ Α., Εισαγωγή στην επιχειρησιακή έρευνα- Θεωρία και Ασκήσεις, Αθήνα 2003.
- ΚΟΥΝΙΑΣ Σ. και ΦΑΚΙΝΟΣ Δ., Γραμμικός Προγραμματισμός, Εκδόσεις ΖΗΤΗ, Θεσσαλονίκη 1999.
- ΛΟΥΚΑΚΗΣ Μ. Επιχειρησιακή έρευνα γραμμικός προγραμματισμός, Εκδοτικό Κέντρο Βορείου Ελλάδας, 1994.
- ΟΙΚΟΝΟΜΟΥ Γ. και ΓΕΩΡΓΙΟΥ Α., ΠΟΣΟΤΙΚΗ ΑΝΑΛΥΣΗ ΓΙΑ ΤΗ ΛΗΨΗ ΔΙΟΙΚΗΤΙΚΩΝ ΑΠΟΦΑΣΕΩΝ, Τόμοι Α και Β, Εκδόσεις Μπένου, Αθήνα 2000.
- ΟΙΚΟΝΟΜΟΥ Γ. και ΤΣΟΤΡΑ Γ . ΠΟΣΟΤΙΚΗ ΑΝΑΛΥΣΗ ΠΕΡΙΠΤΩΣΕΩΝ, Εκδόσεις Μπένου, Αθήνα 1996
- ΠΑΠΑΡΡΙΖΟΣ Κ., Γραμμικός Προγραμματισμός. Εκδόσεις Ζυγός, Θεσσαλονίκη 1999.
- ΣΙΣΚΟΣ Γ., Γραμμικός Προγραμματισμός, Εκδόσεις Νέων Τεχνολογιών, Αθήνα 1998.
- HAMDY TAHA, Επιχειρησιακή Έρευνα Εκδόσεις Α. Τζιολα & ΥΙΟΙ Α.Ε., 2011
- HILLIER F. S. and G. J. Lieberman Introduction Operations research. The McGraw-Hill Companies, 2001
- WINSTON W. L., Operations research (Applications and algorithms). Duxbury Press (International Thomson Publishing) 1994.
- HADLEY G. Linear Programming, Addison-Wesley Publishing Company, INC, 1965
- BERTSIMAS D. and J. N. TSITSIKLIS Introduction to Linear Optimization, Athena Scientific 1997
- GASS S. Linear Programming Methods and Applications, McGraw-Hill 1985

- Related academic journals:

- Mathematical Programming Journal, Series A and Series B
- INFORMS Transactions on Education (ITE)

COURSE OUTLINE
MAE633 - STATISTICAL INFERENCE

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE633**	**SEMESTER**	6th
COURSE TITLE	**Statistical Inference**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English, reading Course)		
COURSE WEBSITE (URL)	http://users.uoi.gr/kzograf/SyllabousInferenceEnglish.pdf		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of the course is to present and study techniques and methods of parametric statistical inference. In particular, the interest is mainly focused on the theoretical development of the field of parameter estimation (point and interval) and the development of the theory of statistical tests for testing statistical hypotheses. Moreover, this course aims to provide the necessary tools and methods which help students to be able to draw statistical conclusions on the basis of experimental data and by utilizing these methods. At the end of the course students will have acquired the theoretical background of the parametric statistical inference methodologies.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these

appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Working independently • Decision-making • Production of free, creative and inductive thinking • Criticism and self-criticism.

SYLLABUS

Point estimation: unbiased, sufficient and efficient estimators, unbiased estimators with minimum variance, the Cramer-Rao lower bound for the variance, Lehmann-Scheffe theory, asymptotic properties of estimators, methods of estimation (method of maximum likelihood and method of moments). Interval estimation. Confidence intervals. Testing Statistical Hypothesis: the Neyman-Pearson lemma, simple and composite hypotheses, uniformly most powerful tests, likelihood ratio tests. Large sample tests. Applications.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in communication with students
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures</td><td>39</td></tr><tr><td>Working independently</td><td>78</td></tr><tr><td>Exercises-Homework</td><td>33</td></tr><tr><td></td><td></td></tr><tr><td>Course total</td><td>**150**</td></tr></table>

learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English) which concentrates on the solution of problems which are motivated by the main themes of the course.

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

Books in English

- Casella, G. and Berger, R. (2002). Statistical Inference. 2nd Edition. Duxbury Advanced Series.
- Hogg, R. V., McKean, J. W. and Craig, A. T. (2005). Introduction to Mathematical Statistics. Pearson Education, Inc.
- Mood, A., Graybill, F. and Boes, D. (1974). Introduction to the Theory of Statistics. McGrawHill.
- Roussas, G. (2003). An Introduction to Probability and Statistical Inference. Academic Press.

Books in Greek

- Ηλιόπουλος, Γ. (2006). Βασικές Μέθοδοι Εκτίμησης Παραμέτρων. Εκδόσεις Αθ. Σταμούλης.
- Κουρούκλης, Σ. (2007). Στατιστική Ι. Πανεπιστήμιο Πατρών.
- Παπαϊωάννου, Τ. και Φερεντίνος, Κ. (2000). Μαθηματική Στατιστική. Εκδόσεις Αθ. Σταμούλης.

COURSE OUTLINE
MAE634 – QUEUEING THEORY

GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="3">School of Science</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="3">Department of Mathematics</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="3">Undergraduate</td></tr>
<tr><td>COURSE CODE</td><td>MAE634</td><td>SEMESTER</td><td>6th</td></tr>
<tr><td>COURSE TITLE</td><td colspan="3">Queueing Theory</td></tr>
<tr><td colspan="2">INDEPENDENT TEACHING ACTIVITIES
if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</td><td>WEEKLY TEACHING HOURS</td><td>CREDITS</td></tr>
<tr><td colspan="2">Lectures</td><td>3</td><td>6</td></tr>
<tr><td colspan="2">Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)</td><td></td><td></td></tr>
<tr><td>COURSE TYPE
general background, special background, specialised general knowledge, skills development</td><td colspan="3">Special Background</td></tr>
<tr><td>PREREQUISITE COURSES</td><td colspan="3"></td></tr>
<tr><td>LANGUAGE OF INSTRUCTION and EXAMINATIONS</td><td colspan="3">Greek</td></tr>
<tr><td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td><td colspan="3">Yes</td></tr>
<tr><td>COURSE WEBSITE (URL)</td><td colspan="3"></td></tr>
</table>

LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course learning outcomes are: the study and development models that describe and analyse the behaviour and performance of queueing systems and their applications for optimal decision making.
Upon successful completion of the course the student will be able to:
- recognize and implement M/M/1 queue model and its variants
- apply the Little's result
- recognize and implements M/G/1 queue model
- apply Markov processes to model queueing systems
- apply queueing models for decision making.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*

- Working independently
- Decision-making
- Adapting to new situations
- Production of free, creative and inductive thinking
- Synthesis of data and information, with the use of the necessary technology.

SYLLABUS

Introduction. Birth death process. Transforms. Markovian Queueing Systems (M/M/1/∞, M/M/m/k, M/M/m/m, M/M/∞/∞). Queue with group arrival, Queue with group services, M/G/1/∞. Applications for optimal decision making.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Software for the calculation of queueing systems performance measures, Email, class web
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each*	(see table below)

Activity	***Semester workload***
Lectures	39
Independent study	78
Fieldwork (3-4 set of homework)	33
Course total	**150**

learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	LANGUAGE OF EVALUATION: Greek METHODS OF EVALUATION: Final exam (100%)

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Φακίνος, Δ. Στοχαστικά Μοντέλα στην Επιχειρησιακή Έρευνα, Σ. Αθανασόπουλος-Σ. Παπαδάμης & ΣΙΑ, Αθήνα, 2003.
- Hillier F.S. and Lieberman, G.J. Introduction to Operations Research, 7/E. McGraw-Hill, New York, 2000.
- Taha, H.A. Operations Research: An Introduction, 9/E. Prentice Hall, Englewood Cliffs, NJ, 2011.
- Ross, S.M. Introduction to Probability Models, 9/E. Academic Press, Amsterdam 2007.

- *Related academic journals:*

- Queueing Systems, Theory and Applications

COURSE OUTLINE
MAE641 – DESIGN AND ANALYSIS OF ALGORITHMS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE641**	**SEMESTER**	6th
COURSE TITLE	**Design and Analysis of Algorithms**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
lectures, laboratory exercises, tutorials, quiz		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	http://www.cs.uoi.gr/~charis/algo641/ http://ecourse.uoi.gr/course/view.php?id=538		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

This course aims at introducing to students the philosophy of fundamental algorithmic background and techniques.

After successfully passing this course the students will be able to:

- Understand basic algorithmic techniques
- Analyze complex algorithms
- Design new algorithmic tools
- Combine already-known techniques for solving new algorithmic problems

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology • Working independently • Team work • Project planning and management.

SYLLABUS

- Fundamental concepts of design and analysis of algorithms
- Analysis of algorithms, Asymptotical growing functions
- Typical running times and data structures (lists, arrays, queues, stacks)
- Stable matching, correctness, priority queue
- «Divide & Conquer» technique, sorting, recursive formulations
- Graph algorithms: BFS, DFS, connectedness, topological ordering
- Greedy algorithms: interval scheduling & shortest paths (Dijkstra)
- Minimum spanning trees(Prim & Kruskal algorithms), Huffman coding
- Dynamic programming: maximum flow, interval scheduling, and Knapsack
- Further Topics: computational complexity and NP-completeness.

TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Lectures</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Use of projector and interactive board during lectures.
• Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs).
• Announcement of assessment marks via the ecourse platform by UOI.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art</td><td><table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td>Lectures</td><td>39</td></tr><tr><td>Working independently</td><td>78</td></tr><tr><td>Team work</td><td>33</td></tr><tr><td></td><td></td></tr><tr><td>Course total</td><td>150</td></tr></table></td></tr>
</table>

workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written examination (70%) • Design and analyze algorithms Exercises (30%) • Design and analyze algorithms

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- [KT] J. Kleinberg and E. Tardos, Σχεδιασμός Αλγορίθμων, ελληνική έκδοση, Εκδόσεις Κλειδάριθμος, 2008
- [CLRS] T. Cormen, C. Leiserson, R. Rivest, and C. Stein, Εισαγωγή στους Αλγορίθμους, ελληνική έκδοση, Πανεπιστημιακές Εκδόσεις Κρήτης, 2012.
- [DPV] S. Dasgupta, C. Papadimitriou, and U. Vazirani, Αλγόριθμοι, ελληνική έκδοση,Εκδόσεις Κλειδάριθμος, 2008

COURSE OUTLINE
MAE642 – NUMERICAL ANALYSIS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE642**	**SEMESTER**	6th
COURSE TITLE	**Numerical Analysis**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

After successful end of this course, students will be able to:

- understand the basic theory of orthogonal polynomials,
- be aware and apply the taught methods of numerical integration
- be aware and apply the taught methods for numerical solution of equations and nonlinear systems,
- implement the above methods with programs on the computer.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Criticism and self-criticism
- Production of free, creative and inductive thinking

SYLLABUS

Sets of Orthogonal Polynomials: Legendre, Chebyshev. Numerical Integration: Newton-Cotes, Chebyshev, Gauss-Legendre, Gauss-Chebyshev. Numerical Solution of Equations: Newton's Method, Secant Method, Aitken-Steffensen Methods. Numerical Solution of Nonlinear Systems: Newton's Method.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	In the class
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study*	see activity table below

Activity	*Semester workload*
Lectures	39
Study and analysis of bibliografy	104
Exercises-Homeworks	33
Course total	**150**

according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examination

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- "Introduction to Numerical Analysis". Akrivis G.D., Dougalis B.A, Crete University Press, 4th Edition, 2010.

COURSE OUTLINE
MAE644 – INTRODUCTION TO SYMBOLIC MATHEMATICS

GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="3">School of Science</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="3">Department of Mathematics</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="3">Undergraduate</td></tr>
<tr><td>COURSE CODE</td><td>MAE644</td><td>SEMESTER</td><td>6th</td></tr>
<tr><td>COURSE TITLE</td><td colspan="3">Introduction to Symbolic Mathematics</td></tr>
<tr><td colspan="2">INDEPENDENT TEACHING ACTIVITIES
if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</td><td>WEEKLY TEACHING HOURS</td><td>CREDITS</td></tr>
<tr><td colspan="2">Lectures and laboratory exercises</td><td>3</td><td>6</td></tr>
<tr><td colspan="2">Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)</td><td></td><td></td></tr>
<tr><td>COURSE TYPE
general background, special background, specialised general knowledge, skills development</td><td colspan="3">Special Background</td></tr>
<tr><td>PREREQUISITE COURSES</td><td colspan="3"></td></tr>
<tr><td>LANGUAGE OF INSTRUCTION and EXAMINATIONS</td><td colspan="3">Greek</td></tr>
<tr><td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td><td colspan="3">Yes</td></tr>
<tr><td>COURSE WEBSITE (URL)</td><td colspan="3"></td></tr>
</table>

LEARNING OUTCOMES

<table>
<tr><td>Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
Guidelines for writing Learning Outcomes</td></tr>
<tr><td>The course is an introduction to symbolic mathematical computations (computer algebra) and programming using a language for processing symbolic mathematical expressions, such as Mathematica. The course examines basic concepts in symbolic algebraic computations and emphases is given on finding the solution of a problem in closed form (exact solution) as opposed to a numerical solution (approximate solution). Using a symbolic language the course examines tools / commands to solve problems from different areas of Mathematics (Calculus, Algebra, Geometry, Statistics, etc.) and how to graphically show the results of solving a problem. Also programming methods are examined which can be used for the solution of a problem in addition to using just ready commands. Much of the course is to present the possibilities and tools available in a programming language for symbolic processing of mathematical expressions. After completing the course the student:</td></tr>
</table>

- Has an understanding of the basic concepts of the symbolic processing of mathematical expressions.
- Can use software packages for symbolically processing mathematical expressions and design/implement procedures using these packages for solving a problem in a closed form.
- Can present and explain the solution to a problem using graphics.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Working independently
- Teamwork
- Analysis of Problem Data
- Can use a computer algebra programming language to solve a problem and if possible to visualize data and solution.
- May solve problems in various disciplines with appropriate mathematical modeling.

SYLLABUS

1. Symbolic mathematical manipulation systems
2. Introduction to Mathematica
3. Representation of symbolic mathematical expressions
4. Numerical computations
5. Symbolic computations
6. Symbolic manipulation of mathematical expressions
7. Basic functions of Mathematica
8. Lists
9. Patterns and transformation rules
10. Input / Output and Files
11. Functions
12. Structures for program flow control (assignment, selection, loops, etc)
13. Programming with Mathematica
14. Graphics
15. Factorization
16. Solving equations and systems
17. Differentiation
18. Integration
19. Series
20. Linear algebra
21. Basic algorithms in symbolic mathematics

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Yes
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	see table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written final exam (70%) comprising: • questions about the processing of symbolic mathematical expressions using programming languages for this purpose Term project (teams) (30%) • students in groups do a term project which basically consists of using Mathematica to work on a specific mathematical topic (presentation of concepts, problem solving, etc.)

Activity	***Semester workload***
Lectures	39
Self study	78
Exercises, projects	33
Course total	**150**

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- SCHAUM'S MATHEMATICA, EUGENE DON, 2006, Publicer KLEIDARITHMOS (translation)
- Mathematics and programming with Mathematica, Karampetakis Nikolaos, Stamatakis Stylianos,,Psomopoulos Evangelos, 2004, Publicer Ziti Pelagia & Co.
- Wolfram, S., The Mathematica Book, 5th Edition, Wolfram Media.
- Abell, M., Braselton, J., Mathematica by Example, 2d Edition, Academic Press, 1997.

- Gaylord, R., Kamin, S., Wellin, P., An Introduction to Programming with Mathematica, 2d Edition, Telos Springer-Verlag, 1996.
- Gray, J., Mastering Mathematica - Programming Methods and Applications, 2d Edition, Academic Press, 1998.

- http://www.wolfram.com/
- http://library.wolfram.com/

COURSE OUTLINE
MAE645 – APPROXIMATION THEORY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE645**	**SEMESTER**	6th
COURSE TITLE	**Approximation Theory**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

After successful end of this course, students will be able to:

- understand the basic theory of approximation in spaces of functions,
- be aware and apply the taught methods for best uniform polynomial approximation, least squares polynomial approximation of functions defined in an interval (continues case), as well as of functions defined in a set of points (discrete case),
- be aware and apply the taught methods for cubic splines polynomial interpolation,
- implement the above methods with programs on the computer.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these

appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Criticism and self-criticism
- Production of free, creative and inductive thinking

SYLLABUS

Introduction to Approximation Theory in Spaces of Functions (Existence – Uniqueness). Polynomial Approximation of Functions: Weierstrass Theorem. Best Uniform Approximation. Least Squares Approximation. Hermite Polynomial Interpolation. Cubic Splines Polynomial Interpolation.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	In the class
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	(see table below)

Activity	***Semester workload***
Lectures	39
Study and analysis of bibliografy	104
Exercises-Homeworks	33
Course total	**150**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examination

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- “Approximation Theory”. Noutsos D., University of Ioannina.

COURSE OUTLINE
MAE646 – TECHNIQUES OF MATHEMATICAL MODELLING

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE646**	**SEMESTER**	6th
COURSE TITLE	**Techniques of Mathematical Modelling**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course is a first introduction to the basic methods of applied mathematics and particularly in perturbation theory. There are many situations in mathematics where one finds expressions that cannot be calculated with absolute precision, or where exact answers are too complicated to provide useful information. In many of these cases, it is possible to find a relatively simple expression which, in practice, is just as good as the complete, exact solution. The asymptotic analysis deals with methods for finding such approximations and has a wide range of applications, both in the fields of pure mathematics such as combinatorics, probability, number theory and applied mathematics and computer science, for example, the analysis of runtime algorithms. The goal of this course is to introduce some of the basic techniques and to apply these methods to a variety of problems.

Upon completion of this course students will be able to: • Recognize the practical value of small or large parameters for calculating mathematical expressions. • Understand the concept of (divergent) asymptotic series, and distinguish between regular and singular perturbations. • Find dominant behaviors in algebraic and differential equations with small and large parameters. • Calculate dominant behavior of integrals with a small parameter. • Find a (in particular cases) the full asymptotic behavior of integrals. • Identify the boundary layers in solutions of differential equations, and apply appropriate expansions to calculate the dominant solutions.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology. • Adapting to new situations. • Decision-making.

SYLLABUS

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

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Yes

<table>
<tr>
<td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td>
<td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Self study</td><td>78</td></tr>
<tr><td>Exercises</td><td>33</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td>
</tr>
<tr>
<td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure.
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
<td>• Weekly homework
• Final project
• Final exam</td>
</tr>
</table>

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

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

COURSE OUTLINE
MAE647 – OBJECT ORIENTED PROGRAMMING

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE647**	**SEMESTER**	6th
COURSE TITLE	**Object Oriented Programming**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
lectures, laboratory exercises, tutorials, quiz		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

This course aims at introducing to students basic concepts and techniques related to object oriented programming.

Introduction to object oriented programming, the notions of classes and objects in programming, Abstraction, Encapsulation, Modularity, Hierarchy.

After successfully passing this course the students will be able to:

- Understand basic programming techniques
- Analyze complex programmes
- Develop software systems that are valuable, reliable, and flexible.

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology • Working independently • Team work • Project planning and management

SYLLABUS

- Introduction to object oriented programming
- Classes and objects in programming
- Properties and methods
- Simple and multiple inheritance
- Abstraction
- Encapsulation
- Modularity
- Hierarchy and Composition

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of projector and interactive board during lectures. • Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs). • Announcement of assessment marks via the ecourse platform by UOI.
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art*	(see table below)

Activity	***Semester workload***
Lectures	39
Working independently	78
Team work	33
Course total	**150**

workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Final written examination (70%) • Exercises (30%)

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Software Engineering - Theory & Practice, S. L. Pfleeger, ISBN 978-960-461-477-6
- Software Engineering, I. Sommerville, ISBN 978-960-461-220-8
- Βασικές Αρχές Γλωσσών Προγραμματισμού, Ellis Horowitz, Εκδόσεις Κλειδάριθμος

COURSE OUTLINE
MAE649 – ICT IN EDUCATION

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE649**	**SEMESTER**	6th
COURSE TITLE	**ICT in education**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises, tutorials, quiz		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment*	*Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology • Working independently • Team work • Project planning and management	

SYLLABUS

ICT as a teaching and learning tool. Basic concepts and didactic tools of Informatics, Internet and educational applications (HTML, JavaScript), Learning Management Systems and tools (LMS, OBS studio-Twitch TV, Jitsi, Zoom), interactive educational technologies (MIT scratch), Multimedia applications programming for educational purposes (Adobe Flash), computational educational tools, educational tools for Mathematics (Geogebra, MathML, Maxima), mobile, IoT and werable educational technologies (BLE, Wi-Fi, Beacons, NFC, touchpad, Android studio, tinkercad, circuits simulator-3D printing), mathematical word processing tools (LateX), image and video processing tools (Gimp, Audacity, SynFig Studio, Blender, Tupitube), programming of mobile educational, tactile, remote surveillance and feedback applications using Blynk.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials,*	see table below

Activity	***Semester workload***
Lectures	39
Working independently	78
Team work	33
Course total	**150**

placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Final written examination (70%) • Exercises (30%)

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

COURSE OUTLINE
MAE711 – FUNCTIONAL ANALYSIS I

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE711**	**SEMESTER**	7th
COURSE TITLE	**Functional Analysis I**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The goal of this course is: To familiarize the student with the notions the basic theorems and the techniques concerning Banach spaces, bounded linear operators between them, dual spaces and especially Hilbert spaces. After completing this course the student will be able to recognize if a given normed linear space is a Banach space, to compute the norm of a bounded linear operator, will be able to use the basic theorems of Functional analysis (Hahn-Banach theorem and its consequences, Open mapping theorem, Uniform Boundedness Principle), and will get the basic theorems and techniques concerning Hilbert spaces (e.g. existence of orthonormal bases, Gram-Schmidt orthogonalization procedure, isometry of every Hilbert space with its dual).

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
This course aims to provide the student with the theoretical background and the fluency of using the basic theorems and techniques of Functional Analysis. Promotes the analytical and synthetic thinking that the student will be able to apply the knowledge acquired in a broader scope including the whole range of mathematical analysis.

SYLLABUS

Linear spaces and algebraic bases (Hamel bases), linear operators. Normed spaces, Banach spaces, classical examples. Bounded linear operators, dual spaces, conjugate operators. Hahn Banach theorem and its consequences. Reflexive spaces. Inner product spaces, Hilbert spaces, orthonormal systems, every Hilbert space is isometric with its dual. Baire's category theorem and some of its consequences in Functional Analysis (Open Mapping Theorem, Closed graph Theorem, Uniform Boundedness Principle, Banach Steinhauss Theorem).

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Teaching on the blackboard from the teacher
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay*	(see table below)

Activity	***Semester workload***
Lectures	39
Individual study	78
solving exercises-homework	33
Course total	**150**

writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Exams in the end of the semester (mandatory), intermediate exams (optional), assignments of exercises during the semester (optional).

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Γενική Τοπολογία και Συναρτησιακή Ανάλυση, Σ. Νεγρεπόντης, Θ. Ζαχαριάδης, Ν. Καλαμίδας, Β. Φαρμάκη, Εκδόσεις Συμμετρία, (κωδικός στο σύστημα Εύδοξος: 45321).
- Στοιχεία Συναρτησιακής Ανάλυσης, Χ. Καρυοφύλλης, Εκδόσεις Ζήτη (κωδικός στο σύστημα Εύδοξος: 11278).
- Συναρτησιακή Ανάλυση, Haim Brezis, Εκδόσεις Ε.Μ.Π. (κωδικός στο σύστημα Εύδοξος: 20956).

COURSE OUTLINE
MAE713 – PARTIAL DIFFERENTIAL EQUATIONS

GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="3">School of Science</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="3">Department of Mathematics</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="3">Undergraduate</td></tr>
<tr><td>COURSE CODE</td><td>MAE713</td><td>SEMESTER</td><td>7th</td></tr>
<tr><td>COURSE TITLE</td><td colspan="3">PARTIAL DIFFERENTIAL EQUATIONS</td></tr>
<tr><td colspan="2">INDEPENDENT TEACHING ACTIVITIES
if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</td><td>WEEKLY TEACHING HOURS</td><td>CREDITS</td></tr>
<tr><td colspan="2">Lectures, laboratory exercises</td><td>3</td><td>6</td></tr>
<tr><td colspan="2">Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)</td><td></td><td></td></tr>
<tr><td>COURSE TYPE
general background, special background, specialised general knowledge, skills development</td><td colspan="3">Special Background</td></tr>
<tr><td>PREREQUISITE COURSES</td><td colspan="3"></td></tr>
<tr><td>LANGUAGE OF INSTRUCTION and EXAMINATIONS</td><td colspan="3">Greek, English</td></tr>
<tr><td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td><td colspan="3">Yes (in English)</td></tr>
<tr><td>COURSE WEBSITE (URL)</td><td colspan="3"></td></tr>
</table>

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes.

The aim of the course is an introduction to Partial Differential Equations (PDE). By this course the students become familiar with a broad area of Analysis that, moreover, has the most applications in other Sciences. The course highlights the wealth of problems that arise in PDE and proposes methods to overcome them. These are presented exemplarily and aim to show the students ways of generalizing known methods and solutions.

The student learns to analyze step-by-step externally posed problems, taking into account relevant informations and aims, and to apply knowledge from “pure” mathematics in order to solve these problems. Moreover, the student learns to interpret the obtained mathematical results.

Concerning specific knowledge, the student learns about (mostly linear) PDE of first and second order for functions of two variables with respect to both, their explicit solution and their qualitative behavior, and obtains an elementary overview of further problems.

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology • Working independently • Working in an interdisciplinary environment • Production of free, creative and inductive thinking

SYLLABUS

Overview of PDE and Systems: Classification with respect to their (non-)linearity, description of the arising problems and of the various kinds of solutions (classical and weak; general and with boundary values)

(for the following we focus on the case of two independent variables)

First order PDE (linear, semi-linear, quasi-linear): Geometric and algebraic observations concerning their qualitative behavior; Initial Value Problems and Method of Characteristics; discussion of the Burgers equation; shock waves and weak solutions; Rankine-Hugoniot condition.

Second order PDE: classification, characteristic directions and curves; wave equation on the line (homogeneous and non-homogeneous); separation of variables for the Laplace and heat equations; Poisson formula.

(alternatively: instead of the discussion of the Burgers equation and of weak solutions, an introduction to the Fourier transform may be given and the heat equation on the line may be discussed)

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory*	• The students may contact the lecturer by e-mail

<table>
<tr><td>education, communication with students</td><td></td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (13X3)</td><td>39</td></tr>
<tr><td>Working independently</td><td>78</td></tr>
<tr><td>Exercises-Homeworks</td><td>33</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure.
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>
• Final written exam (obligatory)
• Home work (optional)</td></tr>
</table>

ATTACHED BIBLIOGRAPHY

Suggested bibliography:

- Γ. Ακρίβης, Ν. Αλικάκος: Μερικές Διαφορικές Εξισώσεις (2η έκδοση), Σύγχρονη Εκδοτική, 2017 (in Greek)
- L. C. Evans: Partial Differential Equations (2nd edition), AMS, 2010

COURSE OUTLINE
MAE714 – SET THEORY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE714**	**SEMESTER**	7th
COURSE TITLE	**Set Theory**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	Through the platform “E-course” of the University of Ioannina		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The plan of the course is an introduction to Axiomatic Set Theory.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
	Respect for difference and multiculturalism
	Respect for the natural environment
Adapting to new situations	*Showing social, professional and ethical responsibility and*

Decision-making *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*

- Working independently
- Team work
- Production of free, creative and inductive thinking

SYLLABUS

The construction of the sets of numbers (Natural, Rational and Real numbers), Axioms for the Zermelo-Fraenkel theory, the Axiom of Choice, Zorn's Lemma, Well ordered sets, Ordinal and Cardinal Numbers and arithmetic of them.

TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Lectures\ Presentations in class</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td></td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Assignments/Essays</td><td>33</td></tr>
<tr><td>Individual study</td><td>78</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure.
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires,</td><td>Written examination at the end of the semester.</td></tr>
</table>

short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Derek Goldrei, Classical Set Theory
- Γ. Μοσχοβάκη, Θεωρία Συνόλων
- Κ. Κάλφα, Αξιωματική Θεωρία Συνόλων
- R. Vaught, Set Theory, An Introduction
- Paul Halmos, Naïve Set Theory

COURSE OUTLINE
MAE718 – HARMONIC ANALYSIS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE718**	**SEMESTER**	7th
COURSE TITLE	**HARMONIC ANALYSIS**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (In English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The aim of the course is the achievement by the undergraduate student of the theoretical background in the theory of Fourier series

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment*
Adapting to new situations	*Showing social, professional and ethical responsibility and*

Decision-making *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment*	*sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

The objective of the course is the undergraduate student's ability achievement in analysis and synthesis of the basic background in Harmonic Analysis.

SYLLABUS

Trigonometric polynomials, partial sums of the Fourier series of a function and L^2-estimates, Bessel's inequality, Lemma Riemann-Lebesgue, Parseval's identity for Riemann integrable functions on $[-\pi,\pi]$, complex Riemann integrable functions defined on an interval, Fourier coefficients and Fourier series, the Dirichlet kernel, criteria for uniform convergence of the Fourier series, convolution of functions and approximations to the identity, Fejer kernel, theorem of Fejer, Poisson kernel, Abel summability of the Fourier series, applications.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures</td><td>39</td></tr><tr><td>Independent study</td><td>78</td></tr><tr><td>Exercises solutions</td><td>33</td></tr><tr><td></td><td></td></tr><tr><td>Course total</td><td>**150**</td></tr></table>
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods*	Written examination at the end of the semester.

of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Yitzhak Katznelson, An Introduction to Harmonic Analysis, Dover Edition.
- Elias M. Stein, Rami Shakarchi, Fourier Analysis, An Introduction, Princeton University Press.

COURSE OUTLINE
MAE722 – RIEMANNIAN GEOMETRY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE722**	**SEMESTER**	7th
COURSE TITLE	**RIEMANNIAN GEOMETRY**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek, English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes.*
The main task is to present the fundamental concepts of Riemannian geometry, i.e., the concepts of curvatures and differential form on manifolds with boundary. Moreover, we will introduce the notions of Riemannian submanifold and will investigate the Gauss-Codazzi-Ricci equations. The lecture will be completed with the presentation of the sphere theorem, a deep and important result that connects geometry with topology. On the completion of the course we expect that the student fully understand the main theorems that were presented during the lectures.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment*	*Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*

- Working independently
- Decision-making
- Production of free, creative and inductive thinking
- Criticism and self-criticism

SYLLABUS

Riemannian metrics, curvature operator, Schur's theorem, differential forms, integration on manifolds, Stokes' theorem, Riemannian submanifolds, sphere theorem.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	see table below

Activity	*Semester workload*
Lectures (13X3)	39
Working independently	78
Exercises-Homeworks	33
Course total	**150**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Weekly exercises and homeworks, presentations, final written exam in Greek (in case of Erasmus students in English) which includes resolving application problems.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- M. do Carmo, *Riemannian Geometry*, Birkhaüser Boston, Inc., Boston, MA, 1992.
- J. Eschenburg, *Comparison Theorems in Riemannian Geometry*, Universität Augsburg, 1994.
- J. Jost, *Riemannian Geometry and Geometric Analysis*, Universitext, Springer, 2017.
- J. Lee, *Riemannian manifolds: An Introduction to Curvature*, Vol. 176, Springer, 1997.
- P. Petersen, *Riemannian Geometry*, Graduate Texts in Mathematics, 171, Springer, 2016.
- Δ. Κουτρουφιώτης, *Διαφορική Γεωμετρία*, Πανεπιστήμιο Ιωαννίνων, 1994.

COURSE OUTLINE
MAE723 – SPECIAL TOPICS IN ALGEBRA

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE723**	**SEMESTER**	7th
COURSE TITLE	**Special Topics in Algebra**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes.*
The principal aim of the course is to introduce the students to the main tools and methods of the theory of modules and rings. At the end of the course we expect the student to have understood the definitions and basic theorems which are discussed in the course, to have understood how they are applied in discrete examples, to be able to apply the material in order to extract new elementary conclusions, and finally to perform some (no so obvious) calculations.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these*

appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
The contact of the undergraduate student with the ideas and concepts of the theory of modules and rings, (a) promotes the creative, analytical and deductive thinking and the ability to work independently, (b) improves his critical thinking and his ability to apply abstract knowledge in various field.	

SYLLABUS

- Elementary Ring Theory.
- Euclidean Domains, Principal Ideal Domains and Unique Factorization Domains.
- Module Theory.
- Modules over polynomial rings.
- Finitely generated and free modules.
- Modules over Principal Ideal Domains.
- Decomposition Theorems.
- Applications to Linear Algebra and Abelian groups.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	

Activity	***Semester workload***
Lectures (13X3)	39
Working independently	78
Exercises-Homeworks	33
Course total	**150**

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English) which includes resolving application problems.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Μ. Μαλιάκας – Ο. Ταλέλλη: «Πρότυπα πάνω σε Περιοχές Κυρίων Ιδεωδών και Εφαρμογές», Εκδόσεις Σοφία.
- Μ. Μαλιάκας: «Εισαγωγή στη Μεταθετική Άλγεβρα», Εκδόσεις Σοφία.
- N. Jacobson: "Basic Algebra I", Dover Publications (1985).
- S. Lang: «Άλγεβρα», Εκδόσεις Πολιτεία (2010).

COURSE OUTLINE
MAE725 - RING THEORY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE725**	**SEMESTER**	7th
COURSE TITLE	**Ring Theory**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek, English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	http://users.uoi.gr/abeligia/RingTheory/RingTheory2018 /RingTheory2018.html		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The principal aim of the course is to introduce the students to the main tools and methods of the theory of non-commutative rings, where by non-commutative ring is meant an associative ring with unit, which is not necessarily commutative. The main objective of the course is to present the basic theory of rings and the ideas which lead to the proof of: (a) the fundamental theorem of Wedderburn-Artin concerning the structure of semisimple rings and, (b) the fundamental density theorem of Jacobson concerning the structure of primitive rings. A key element in the study of a ring is the interaction and interplay between ring-theoretical properties of the ring and the structure of its (left or right) ideals or modules. In the course a variety of

examples and constructions will be analyzed and various applications of ring theory to other areas of mathematics (in particular of algebra) will be explored. At the end of the course we expect the student to have understood the definitions and basic theorems which are discussed in the course, to have understood how they are applied in discrete examples, to be able to apply the material in order to extract new elementary conclusions, and finally to perform some (no so obvious) calculations.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
The course aims to enable the undergraduate student to acquire the ability to analyse and synthesize basic knowledge of the Theory of Rings, which is an important part of modern algebra. The contact of the undergraduate student with the ideas and concepts of the theory of rings, (a) promotes the creative, analytical and deductive thinking and the ability to work independently, (b) improves his critical thinking and his ability to apply abstract knowledge in various field.

SYLLABUS

Rings – Homomorphisms – Ideals – Quotient Rings – Modules – Rings arising from various constructions – Algebras – Group algebras – Modules over group algebras – Module homomorphisms – The bicommutator – Simple faithful modules and primitive rings – Artin rings – Simple finite dimensional algebras over algebraically closed fields – Artinian modules – Noetherian rings and modules – Jacobson radical.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face to face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students.*	- Teaching Material: Teaching material in electronic form available at the home page of the course. - Communication with the students: 1. Office hours for the students (questions and problem solving). 2. Email correspondence 3. Weekly updates of the homepage of the course.

<table>
<tr>
<td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.</td>
<td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (13x3)</td><td>39</td></tr>
<tr><td>Working independently</td><td>78</td></tr>
<tr><td>Exercises - Homeworks</td><td>33</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td>
</tr>
<tr>
<td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure.
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
<td>Combination of: Weekly homework, presentations in the class by the students, written work, and, at the end of the semester, written final exams in Greek (in case of Erasmus students, in English) which includes analysis of theoretical topics and resolving application problems.</td>
</tr>
</table>

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*
- Nathan Jacobson: "Basic Algebra I & II", W. H. Freeman and Company, (1985 & 1989).
- I.N. Herstein: "Non-commutative Rings", AMS, Carus Mathematical Monographs 85, (1971).
- Luis Rowen: "Ring Theory (student edition)", Academic Press, Second Edition, (1991).
- T.Y. Lam: "A First Course in Noncommutative Rings", GTM 131, Springer, (2001).
- P. M. Cohn: "Introduction to Ring Theory", Springer (2000).
- Y. Drozd and V. Kirichenko: "Finite Dimensional Algebras", Springer (1994).

COURSE OUTLINE
MAE727 – EUCLIDEAN AND NON EUCLIDEAN GEOMETRIES

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE727**	**SEMESTER**	7th
COURSE TITLE	**Euclidean and Non Euclidean Geometries**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek, English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes.*

This is an introductory course on non Euclidean geometries. The aim is to study how the attempt to prove Euclid's fifth postulate led the way to non Euclidean geometries.

On completion of the course the student should be familiar with the foundations of Euclidean and non Euclidean geometries.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the	*Project planning and management*
	Respect for difference and multiculturalism

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

- Working independently
- Decision-making
- Production of free, creative and inductive thinking
- Criticism and self-criticism

SYLLABUS

Euclid's geometry, Hilbert's system of axioms, the fifth postulate, compatibility of axioms, neutral geometry, independence of the fifth postulate, hyperbolic geometry, Poincarẻ model, spherical geometry, Platonic solids.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	see table below

Activity	***Semester workload***
Lectures (13X3)	39
Working independently	78
Exercises-Homeworks	33
Course total	**150**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English) which includes resolving application problems.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Π. Πάμφιλου, Γεωμετρία, Εκδόσεις Τροχαλία, 1989.
- M.J. Greenberg, Euclidean and non-Euclidean Geometry-Development and History, W.H. Freedmann and Company, 1973.
- R. Hartshorne, Geometry: Euclid and beyond, Springer, 2000.
- H. Meschkowski, Noneuclidean Geometry, Academic Press, 1964.

COURSE OUTLINE
MAE728 – DIFFERENTIABLE MANIFOLDS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE728**	**SEMESTER**	7th
COURSE TITLE	**Differentiable Manifolds**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek, English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	http://users.uoi.gr/ansavas/lectures/id-5.html		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes.*

In this lecture we introduce basic notions of modern Differential Geometry. More precisely, we introduce among others the notions of manifold, tangent bundle, connection, parallel transport and Riemannian metric.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment*

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

- work autonomously
- work in teams
- develop critical thinking skills.

SYLLABUS

- Smooth manifolds.
- Smooth maps.
- Tangent vectors.
- Vector fields.
- Regular values and Sard's Theorem.
- Homotopy and Isotopy.
- Lie bracket.
- Frobenius' Theorem.
- Connections and parallel transport.
- Riemannian metrics.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well*	see table below

Activity	***Semester workload***
Lectures	39
Autonomous Study	111
Course total	**150**

as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Weakly homeworks and written final examination.

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- M. do Carmo, *Riemannian Geometry*, Birkhaüser Boston, Inc., Boston, MA, 1992.
- V. Guillemin & A. Pollack, *Differentiable Topology*, Prentice-Hall, Inc, Englewood Cliffs, 1974.
- J. Lee, *Introduction to Smooth Manifolds*, Graduate Texts in Mathematics, 218, 2013.
- J. Milnor, *Topology From the Differentiable Viewpoint*, Princeton University Press, NJ, 1997.
- L. Tu, *An Introduction to Manifolds*, Universitext. Springer, New York, 2011.
- Δ. Κουτρουφιώτης, *Διαφορική Γεωμετρία*, Πανεπιστήμιο Ιωαννίνων, 1994.

COURSE OUTLINE
MAE729 – TOPOLOGICAL MATRIX GROUPS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE729**	**SEMESTER**	7th
COURSE TITLE	**Topological Matrix Groups**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Interactive, Presentations		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background, skills development		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek, English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	http://users.uoi.gr/nkechag/TopologicalGroupTheory.pdf		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes.*
The aim of the course is to provide an introduction to Lie theory through matrix groups. The main subject of study is the closed subgroups of the general linear group. Our study is extended from real to complex and quaternion numbers. The corresponding linear groups are in fact topological groups and an introduction of basic properties of topological group is also provided. The Lie algebra of a matrix group is defined. The special orthogonal, unitary and symplectic groups provide important example of Lie algebras. Lie algebras are studied using the exponential map. Finally Lie groups are defined.

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Study particular characteristics of group theory in topology and geometry • Independent and team work • Working in an interdisciplinary.

SYLLABUS

- General linear groups
- Real and Complex algebras, Quaternions. Matrix algebras
- Inner product, orthogonal, unitary and symplectic groups
- Homomorphisms
- Differential curves, tangent vectors. Dimension of a matrix group
- Differential homomorphisms
- Expontential and logarithmic funcions. Lie algebras
- Special orthogonal and symplectic groups
- Topological groups, manifolds
- Maximal tori
- Differential manifolds, Lie groups.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Communication with students
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching,*	**Activity** / **Semester workload** Lectures: 39 Working hours in class: 8 Project: 30 Assignments: 33 Final exam: 41 Course total: **150**

Activity	*Semester workload*
Lectures	39
Working hours in class	8
Project	30
Assignments	33
Final exam	41
Course total	**150**

educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written Examination, Oral Presentation, written assignments.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- J. F. Adams, Lectures on Lie groups, University of Chicago Press, 1969.
- M. L. Curtis, Matrix Groups, Springer-Verlag, 1979.
- R. Howe. Very basic Lie theory, American math. monthly,90, 1983.

COURSE OUTLINE
MAE731 – DECISION THOERY - BAYESIAN THEORY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE731**	**SEMESTER**	7th
COURSE TITLE	**Decision Theory – Bayesian Theory**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English, reading Course)		
COURSE WEBSITE (URL)	http://users.uoi.gr/abatsidis/731.html		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

This course consists of two modules: the Decision Theory and Bayes Theory. The Decision Theory deals with problems of decision-making. Object of Statistical Decision Theory is
decisions about unknown numerical quantities (parameters) by utilizing the presence of statistical knowledge. The aim of the course is the evaluation of the performance of the estimators subject to properties such as the unbiasedness, sufficiency, consistency etc.

The second part of the course gives an introduction to Bayesian statistical approach.
At the end of the course the student should be able to compare Bayes and classical approaches and evaluate the "performance" of different estimators by using various criteria.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Working independently • Decision-making • Production of free, creative and inductive thinking • Criticism and self-criticism

SYLLABUS

Decision Theory: decision function, loss function, risk function, admissible and minimax estimators; Bayesian inference: Bayes estimators, Bayes confidence intervals, minimax and Bayes tests.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	*Use of ICT in communication with students*
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study*	*Activity* / *Semester workload*: Lectures: 39 Working independently: 78 Exercises-Homework: 33 Course total: **150**

Activity	***Semester workload***
Lectures	39
Working independently	78
Exercises-Homework	33
Course total	**150**

according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English) which concentrates on the solution of problems which are motivated by the main themes of the course.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Books in English

- Berger, J.O. (1985) Statistical decision theory and Bayesian analysis. Springer.
- Bernardo J. M. & Smith A. F. M., (1994). Bayesian Theory, Wiley, London.

Books in Greek:

- Κ. Φερεντίνος (2005). Εκθετική οικογένεια κατανομών Θεωρία Bayes, Πανεπιστημιακές Παραδόσεις.

COURSE OUTLINE
MAE732 – TOPICS IN OPERATIONS RESEARCH

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE732**	**SEMESTER**	7th
COURSE TITLE	**Topics in Operations Research**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The course learning outcomes are: the introduction of the students to integer programming formulations, the introduction of the students to the dynamic programming methodology, the introduction of the students to techniques and tools for decision-making under uncertainty Upon successful completion of the course the student will be able to: • model and solve integer programming problems and understand their differences with the linear programming problems. • understand the basic principles of dynamic programming • construct simple recursive dynamic programming equations • solve known optimization problems using dynamic programming • describe and handle decision making problems under uncertainty.

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Working independently • Decision-making • Adapting to new situations • Production of free, creative and inductive thinking • Synthesis of data and information, with the use of the necessary technology

SYLLABUS

Integer linear programming (integer and mixed integer problems formulation, integer programming algorithms). Dynamic programming (Bellman principle of optimality, finite and infinite horizon problems, Applications on: Routing problems, Equipment-Replacement Problem, inventory problems, etc). Decision analysis (General characteristics of decision problems, decisions under uncertainty, decision trees, risk analysis).

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Lindo/Lingo Software, Email, class web
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	see table below

Activity	*Semester workload*
Lectures	39
Independent study	78
Fieldwork (3-4 set of homework)	33
Course total	**150**

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	LANGUAGE OF EVALUATION: Greek METHODS OF EVALUATION: Final exam (100%)

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- HAMDY TAHA, Επιχειρησιακή Έρευνα Εκδόσεις Α. Τζιολα & ΥΙΟΙ Α.Ε., 2011
- Υψηλάντης Π. Μέθοδοι και τεχνικές λήψης αποφάσεων, "Εκδόσεις ΠΡΟΠΟΜΠΟΣ" ΚΙΜΕΡΗΣ Κ. ΘΩΜΑΣ, 2015.
- Bellman, R.E.. *Dynamic Programming*, Princeton University Press, 1957, Princeton, NJ. Republished 2003
- Bertsekas D. P. Dynamic Programming and Optimal Control, Vols. I and II, Athena Scientific, 1995, (3rd Edition Vol. I, 2005, 4th Edition Vol. II, 2012),
- BERTSIMAS D. and J. N. TSITSIKLIS Introduction to Linear Optimization, Athena Scientific 1997
- HADLEY G. Linear Programming, Addison-Wesley Publishing Company, INC, 1965
- HILLIER F. S. and G. J. Lieberman. Introduction Operations research. The McGraw-Hill Companies, 2001
- WINSTON W. L., Operations research (Applications and algorithms). Duxbury Press (International Thomson Publishing) 1994.

- Related academic journals:

- Mathematical Programming Journal, Series A and Series B
- INFORMS Transactions on Education (ITE)

COURSE OUTLINE
MAE733 – REGRESSION AND ANALYSIS OF VARIANCE

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE733**	**SEMESTER**	7th
COURSE TITLE	**Regression and Analysis of Variance**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English, reading Course)		
COURSE WEBSITE (URL)	http://users.uoi.gr/kzograf/SyllabousRegressionEnglish.pdf		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of the course is the presentation, study and application of linear models and more precisely the simple and multiple linear regression models and analysis of variance of one or more factors, as well. The general linear model is presented to unify the above mentioned regression and analysis of variance models. This course is focused on the theory of linear models and their applications in modelling statistical data. At the end of the course, students understand the aforementioned issues of the theory of linear models and it is, moreover, expected that they will be able to apply the theory of linear models for the analysis of real statistical data.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Working independently
- Decision-making
- Production of free, creative and inductive thinking
- Criticism and self-criticism

SYLLABUS

Theory of linear models. Simple linear regression. Multiple linear regression. One-and multi-way analysis of variance. Multiple comparisons. Applications.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in communication with students
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	see table below

Activity	***Semester workload***
Lectures	39
Working independently	78
Exercises-Homework	33
Course total	**150**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English) which concentrates on the solution of problems which are motivated by the main themes of the course.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Books in English:

- Kutner, M. H., Nachtsheim, Ch., Neter, J. and Li. W. (2004). Applied Linear Statistical Models. 5th Edition, McGraw-Hill.
- Montgomery, D. C., Peck, E. A. και Vining, G. G. (2006). Introduction to linear regression analysis. 4th Edition, Wiley.
- Rencher, A. C. (2000). Linear models in statistics. Wiley.
- Sahai, H. and Ageel, M. (2000). The Analysis of Variance. Birkhauser.

Books in Greek:

- Draper, N. και Smith, H. (1997). Εφαρμοσμένη Ανάλυση Παλινδρόμησης. 2η Αγγλική Έκδοση. Μετάφραση-Επιμέλεια: Ε. Χατζηκωνσταντινίδης, Α. Καλαματιανού. Εκδόσεις Παπαζήση.
- Καρακώστας, Κ. (2002). Γραμμικά Μοντέλα: Παλινδρόμηση και Ανάλυση Διακύμανσης. Πανεπιστήμιο Ιωαννίνων.
- Κούτρας, Μ. και Ευαγγελάρας, Χ. (2011). Ανάλυση Παλινδρόμησης. Εκδόσεις Αθ. Σταμούλης
- Οικονόμου, Π. και Καρώνη, Χ. (2010). Στατιστικά Μοντέλα Παλινδρόμησης, Εκδόσεις Συμεών

COURSE OUTLINE
MAE734 - PRODUCTION PLANNING AND INVENTORY CONTROL

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE734**	**SEMESTER**	7th
COURSE TITLE	**Production Planning and Inventory Control**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of the course, students will:
- understand the basic principles of control of production and inventory systems
- understand the performance measures for production and inventory systems and how these measures affect systems cost
- use appropriate tools to find cost-effective production and inventory policies
- understand how the variability affects the systems performance.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Working independently
- Decision-making
- Adapting to new situations
- Production of free, creative and inductive thinking
- Synthesis of data and information, with the use of the necessary technology

SYLLABUS

Introduction. Forecasting (Introduction. Methods. Errors. Causal methods. Qualitative methods). Aggregate planning (Basic models and solution methodologies). Inventory Control (Deterministic Models: Economic Order Quantity (EOQ) model, EOQ Model with Discounts, EOQ Model with shortages, Economic Production Quantity (EPQ) Model). Finite Horizon Models - Wagner-Whitin Algorithm. Stochastic models: Newsboy model. (r, Q) and (s, S) Policies) Material Requirements Planning (MRP)). Production Scheduling.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Email, class web
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each*	

Activity	***Semester workload***
Lectures	39
Independent study	78
Fieldwork (3-4 set of homework)	33
Course total	**150**

learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	LANGUAGE OF EVALUATION: Greek METHODS OF EVALUATION: Final exam (100%)

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Ιωάννου, Γ., Διοίκηση Παραγωγής και Υπηρεσιών, Εκδόσεις Α. Σταμούλης, Αθήνα-Πειραιάς, 2005.
- Παππής, Κ., Προγραμματισμός Παραγωγής, Εκδόσεις Α. Σταμούλης, Αθήνα-Πειραιάς, 1995.
- Ψωϊνός, Δ.Π., Οργάνωση και Διοίκηση Εργοστασίων, Τόμος 2: Προγραμματισμός και Έλεγχος Παραγωγής, Εκδόσεις Ζήτη, Θεσσαλονίκη, 1994.
- Nahmias, S., Production and Operations Analysis, McGraw-Hill: Series in Operations and Decision Sciences, 2009.
- Shim, J.K. and Siegel, J.G., Διοίκηση Εκμετάλλευσης (μεταφρ.), Εκδόσεις Κλειδάριθμος: Σειρά Οικονομία και Επιχείρηση, Αθήνα, 2002.
- Silver, E. A., D. F. Pike, and R. Peterson. Inventory Management and Production Planning and Scheduling, 3rd ed. Hoboken, NJ: Wiley, 1998.
- Tersine R. J. Διαχείριση υλικών και συστήματα αποθεμάτων (μεταφρ.), Εκδόσεις Παπαζηση ΑΕΒΕ, 1984

- *Related academic journals:*

- Production and Operations Management
- Production Planning and Control.

COURSE OUTLINE
MAE741 – DATABASE SYSTEMS AND WEB APPLICATIONS DEVELOPMENT

GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="3">School of Science</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="3">Department of Mathematics</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="3">Undergraduate</td></tr>
<tr><td>COURSE CODE</td><td>MAE741</td><td>SEMESTER</td><td>7th</td></tr>
<tr><td>COURSE TITLE</td><td colspan="3">Database Systems and Web applications development</td></tr>
<tr><td colspan="2">INDEPENDENT TEACHING ACTIVITIES
if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</td><td>WEEKLY TEACHING HOURS</td><td>CREDITS</td></tr>
<tr><td colspan="2">Lectures-Laboratory</td><td>3</td><td>6</td></tr>
<tr><td colspan="2">Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)</td><td></td><td></td></tr>
<tr><td>COURSE TYPE
general background, special background, specialised general knowledge, skills development</td><td colspan="3">Special Background</td></tr>
<tr><td>PREREQUISITE COURSES</td><td colspan="3"></td></tr>
<tr><td>LANGUAGE OF INSTRUCTION and EXAMINATIONS</td><td colspan="3">Greek</td></tr>
<tr><td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td><td colspan="3">Yes</td></tr>
<tr><td>COURSE WEBSITE (URL)</td><td colspan="3">https://spooky.math.uoi.gr/eclass</td></tr>
</table>

LEARNING OUTCOMES

<table>
<tr><td>Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
• Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
• Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
• Guidelines for writing Learning Outcomes</td></tr>
<tr><td>Students knowledge acquisition of design, implementation procedures and methodologies using Relational DataBase Management Systems (RDBMS), as well as familiarity with the development of Internet programming applications using PHP, JavaScript, jQuery and AngularJS.
Basic Internet programming concepts HTML, CSS, Database relationships, tables and structure. Concepts and architecture of Database Systems, Relational model, Internet programming languages and Tier System architecture. Data Modelling using the relational SQL Database Language MariaDB, SQL Queries, Normalization, Normal forms, Non relational Databases - MongoDB. Databases on the Internet using programming languages, PHP programming language, using PHP for mathematical problems, using MySQLi Api, Bootstrap, Introduction to JavaScript, AJAX, JSON and jQuery.</td></tr>
</table>

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
• Data search, analysis and synthesis using Information Technologies • Decision making • Project design and implementation • Working independently	

SYLLABUS

1. Data models with emphasis on relational model. Introduction to relational algebra and relational calculus. Conceptual Models: Entity-Associations Model. Theory of dependencies. Form normalization (1NF, 2NF, 3NF, BCNF). Database design. Introduction to Database Management Systems.
2. SQL language with practical application using MariaDB. Create tables, modify fields, add records to a table, Database tables management.
3. Create basic SQL queries in MariaDB tables.
4. SQL joins, SQL table associations-relations, foreign keys, stored procedures, triggers.
5. Introduction to the web and its capabilities. Web page development. Basic HTML content formatting commands, Add images, create tables, lists and frames, HTML layers, divs HTML 5 additional commands.
6. HTML and content formatting using Cascading Style Sheets (CSS). Advanced ways of responsive formatting using the Bootstrap library.
7. Introduction to JavaScript, ways to import JavaScript into HTML, JavaScript DOM, functions and classes.
8. Introduction to PHP, basic language capabilities, input output, data types, conditions, repetitive loops.
9. Create forms in HTML and retrieve form information using PHP and JavaScript (AJAX), using GET, POST methods.
10. Use of PHP and MySQL, presentation of PHP input functions and retrieval of information from DB tables. (mysqli-PDO api). Creating dynamic web pages.
11. Mathematical extensions of PHP, PHP and data processing from DB to solve linear equation problems, presentation of the PHP-LAPACK class.
12. Mathematical extensions of PHP, PHP and statistical data processing from DB, presentation of PHP statistical functions.
13. Asynchronous communication with DB, PHP and AJAX, using the jQuery library and JSON configuration. Presentation and use of AngularJS and NodeJS frameworks.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Micro-computers Laboratory
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	***Activity*** / ***Semester workload*** Lectures: 39 Working Independently: 78 Exercises-Homework: 33 Course total: **150**
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Using new ICT and metrics of the asynchronous e-learning platform (5%) Examination of laboratory exercises (10%) Semester work and written examination

Activity	*Semester workload*
Lectures	39
Working Independently	78
Exercises-Homework	33
Course total	**150**

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- PHP and MySQL Web Development, 5th Edition., Thomson Laura, Welling Luke, ISBN-13: 978-0321833891, 2017.
- PHP 6 AND MYSQL 5 FOR DYNAMIC WEB SITES, 5th Edition, LARRY ULLMAN, ISBN-13: 978-0134301846, 2018
- JAVASCRIPT & JQUERY interactive front-end web development, Jon Duckett, ISBN-13: 978-1118531648, 2017.

COURSE OUTLINE
MAE742 - INTRODUCTION TO COMPUTATIONAL MATHEMATICS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE742**	**SEMESTER**	7th
COURSE TITLE	**Introduction to Computational Mathematics**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Science is based on two major pillars, both theoretical and experimental. However, over the last few decades scientific computing has emerged and recognized as the third pillar of science. Now, in most scientific disciplines, theoretical and experimental studies are linked to computer analysis. In order for the graduate student to be able to stand with claims in the modern scientific and work environment, knowledge in computational techniques is considered a necessary qualification.

The course aims to introduce the student into the field of computational mathematics, emphasizing the implementation of numerical methods using computers. The student will be able to familiarize himself with Matlab and Python programming languages, the most widespread for performing scientific calculations. Working autonomously and in groups, the student will be required to

implement computational methods related to the fields of numerical analysis and numerical linear algebra.
Specifically, the objectives of this laboratory course are:

- Familiarity with Matlab and Python programming languages to implement numerical methods and graphical design of the numerical solutions
- Implementation of polynomial interpolation and function approximation
- Apply numerical integration
- Solving linear and nonlinear equations
- Solving systems of linear equations
- Study of direct and iterative methods.

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…*

The course aims to enable the student to:

- Search, analyze and synthesize data and information, using the available technologies
- Work autonomously
- Work in a team
- Promote free, creative and inductive thinking

SYLLABUS

- Vector and matrix definition and calculations
- Basic commands and functions
- Graphic representation of the numerical results
- Polynomial interpolation: Lagrange Method, Newton's Method
- Numerical integration: Simple and generalized types of numerical integration, rectangular rule, trapezoid rule, Simpson rule, Gauss integration
- Numerical solution of non-linear equations: iterative methods, bisection method, fixed point method, Newton's method
- Numerical solution of linear systems - Direct methods: Gauss elimination, LU decomposition.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	In the laboratory

<table>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of scientific computing software packages</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Study of bibliography</td><td>39</td></tr>
<tr><td>Laboratory exercises</td><td>39</td></tr>
<tr><td>Home exercises (project)</td><td>33</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Total</td><td>150 hrs</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure.
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>• Weekly assignments
• Final project
• Written examination at the end of the semester</td></tr>
</table>

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Introduction to Numerical Analysis, G.D. Akrivis, V.A. Dougalis, 2010 (in Greek).
- Numerical Linear Algebra, V. Dougalis, D. Noutsos, A. (in Greek).
- A Primer on Scientific Programming with Python, H. P. Langtangen, Springer-Verlag Berlin Heidelberg, 5th Edition, 2016.
- Programming for Computations- MATLAB/Octave, S. Linge, H. P. Langtangen, Springer International Publishing, 2016 (in Greek).

COURSE OUTLINE
MAE743 – INTRODUCTION TO MATHEMATICAL PHYSICS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE743**	**SEMESTER**	7th
COURSE TITLE	**Introduction to Mathematical Physics**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://users.uoi.gr/mxenos http://www.math.upatras.gr/~maik/MF.html		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The course is an introduction to the basic analytic and numerical methods of Mathematical Physics. The objectives of the course are: • Development of the theoretical background in matters relating to mathematical physics. • Ability of the student to apply the basic concepts of mathematical physics. • Upon completion of this course the student will be able to solve with analytical and approximate mathematical methods simple problems of mathematical physics and deepen further understanding of such methods.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims to enable the undergraduate students to develop basic knowledge of Mathematical Physics and in general of Applied Mathematics. The student will be able to cope with problems of Applied Mathematics giving the opportunity to work in an international multidisciplinary environment.	

SYLLABUS

Short introduction of linear vector spaces, Vector spaces of infinite dimensions, The Sturm-Liouville problem, Orthogonal polynomials and special functions, Multi-dimensional problems, Operator Theory, Applications in modern Physics.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	In class
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of computer (Mechanics) lab
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well*	(see activity table below)

Activity	*Semester workload*
Lectures	39
Study of theor	78
Home exercises	33
Total	**150**

as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Weekly assignments • Final project • Written examination at the end of the semester

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Mathematical methods for physics, Volume 1, J.D. Vergados, 1st Edition. 2009 (in Greek).
- Applied mathematics, D.J. Logan, 1st Edition, 2010 (in Greek).

COURSE OUTLINE
MAE744 – NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE744**	**SEMESTER**	7th
COURSE TITLE	**Numerical Solution of Ordinary Differential Equations**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://users.uoi.gr/mxenos http://www.math.upatras.gr/~maik/AESDE.html		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The course is an introduction to the basic methods for the numerical solution of ordinary differential equations. The objectives of the course are: • Development of theoretical background in matters concerning the numerical solution of ordinary differential equations (ODEs) and ODE systems. • Ability of using numerical methods for solving ODEs with computational programs that will help with the implementation, e.g. Mathematica, Matlab etc. • Upon completion of this course the student will be able to use numerical methods for solving mathematical problems that may not have analytical solution and further deepen the understanding of such methods.

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims to enable undergraduate students to develop the ability to analyze and synthesize basic knowledge of Numerical Analysis with the help of computers to numerically solve difficult problems in mathematics and/or physics. This will give to the student the opportunity to work in an international environment.

SYLLABUS

Difference Equations, Initial Value Problems, One step methods (Euler – explicit and implicit, Runge Kutta methods), Multiple steps methods (Adams-Bashforth, Adams-Moulton, Predictor-Corrector methods). Convergence, Stability, Compatibility, Stiff ODE systems, Boundary Value Problems, Shooting method, Finite differences, Eigenvalue problems.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	In class
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of computer (Mechanics) lab
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures</td><td>39</td></tr><tr><td>Study of theory</td><td>78</td></tr><tr><td>Home exercises</td><td>33</td></tr><tr><td></td><td></td></tr><tr><td>Total</td><td>**150**</td></tr></table>

learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Weekly assignments • Final project • Written examination at the end of the semester

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Numerical Methods for Ordinary Differential Equations, 2nd Edition, G.D. Akrivis, V.A. Dougalis, 2012 (in Greek).
- Numerical Analysis: Ordinary Differential Equations, M.N. Vrahatis, 2012 (in Greek).

COURSE OUTLINE
MAE745 – AUTOMATA THEORY AND FORMAL LANGUAGES

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE745**	**SEMESTER**	7th
COURSE TITLE	**Automata Theory and Formal Languages**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://nlampp-lab.uoi.gr/lab/		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The goal of this course is the deeper understanding of Automata Theory and Languages. During the course a detailed examination of the following topics are done: • Introductory concepts of Automata , Computability and Complexity as well as basic definitions, basic theorems and inductive proofs • Finite State Machines and Languages, Finite Automata (Deterministic FA, Nondeterministic FA, FA with Epsilon-Transitions) and their applications, Regular Expressions and Languages, derivation trees. Removing Nondeterminism . Equivalence NFA and NFA with ε-moves. Minimization of DFA, Pumping Lemma • FA and Grammars. Grammars of Chomsky Hierarchy. Regular Sets (RS). Properties of Regular Languages. RS and FA. Finding a correspondence Regular Expression of a FA. Abilities and disabilities of FA.

- Context-Free Grammars and Languages, Pushdown Automata (Deterministic PDA, Acceptance by Final State, Acceptance by Empty Stack) , Properties of Context-Free Languages. Correspondence PDA and Context-Free Languages.
- Introduction of Turing Machines. Standard TM, useful techniques for TM constructions. Modification of TM. TM as procedure.
- Unsolvability. The Church-Turing Thesis. The Universal TM. The Halting Problem for TM. Computational Complexity. NP-complete problems.

After completing the course the student can handle:

- theoretical documentation of problems
- solving exercises
- tracking applications

which related to Finite Automata, Pushdown Automata, and Turing Machines as well as to Unsolvability , to Computational Complexity and to NP-complete problems.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Handle new problems
- Decision making
- Implementation- Consolidation

SYLLABUS

- Introductory concepts of Automata , Computability and Complexity as well as basic definitions, basic theorems and inductive proofs
- Finite State Machines and Languages, Finite Automata (Deterministic FA, Nondeterministic FA, FA with Epsilon-Transitions) and their applications, Regular Expressions and Languages, derivation trees. Removing Nondeterminism . Equivalence NFA and NFA with ε-moves. Minimization of DFA, Pumping Lemma
- FA and Grammars. Grammars of Chomsky Hierarchy. Regular Sets (RS). Properties of Regular Languages. RS and FA. Finding a correspondence Regular Expression of a FA. Abilities and disabilities of FA.
- Context-Free Grammars and Languages, Pushdown Automata (Deterministic PDA, Acceptance by Final State, Acceptance by Empty Stack) , Properties of Context-Free Languages. Correspondence PDA and Context-Free Languages.
- Introduction of Turing Machines. Standard TM, useful techniques for TM constructions. Modification of TM. TM as procedure.

- Unsolvability. The Church-Turing Thesis. The Universal TM. The Halting Problem for TM. Computational Complexity. NP-complete problems.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Yes, use of Natural Language and Mathematical Problems Processing Laboratory
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	see table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Final test

Activity	***Semester workload***
Lectures	39
Self study	78
Exercises	33
Course total	**150**

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Βιβλίο [11776]: Στοιχεία θεωρίας υπολογισμού (Elements of Computation Theory), Lewis Harry R.,Παπαδημητρίου Χρίστος Χ.
- Βιβλίο [257]: ΕΙΣΑΓΩΓΗ ΣΤΗ ΘΕΩΡΙΑ ΥΠΟΛΟΓΙΣΜΟΥ (Introduction in Computation Theory), SIPSER MICHAEL

COURSE OUTLINE
MAE746 – GRAPH THEORY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE746**	**SEMESTER**	7th
COURSE TITLE	**Graph Theory**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises, tutorials, quiz		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	http://ecourse.uoi.gr/course/view.php?id=358		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
Introduction to fundamental concepts of graph theory and understanding of algorithmic techniques of graph problems. Basic definitions and concepts, Connectivity and Biconnectivity, Trees, Spanning Trees and Rooted trees, Eulerian and Hamiltonian graphs, Otpimization problems on graphs, Planar graphs, Graphs, connectivity, spanning trees, Eulerian & Hamiltonian graphs, Graph coloring, Clique, Independent set, Vertex cover, Planar graphs.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these*

appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology • Working independently • Team work • Project planning and management

SYLLABUS

- Introduction to basic graph concepts
- Connectivity and biconnectivity
- Trees
- Eulerian & Hamiltonian graphs
- Graph optimization problems
- Planar graphs

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of projector and interactive board during lectures. • Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs). • Announcement of assessment marks via the ecourse platform by UOI.
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	

Activity	*Semester workload*
Lectures	39
Working independently	78
Team work	33
Course total	**150**

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Final written examination (70%) • Exercises (30%)

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Κυρούσης Λευτέρης Μ., Μπούρας Χρήστος Ι., Σπυράκης Παύλος Γ., Σταματίου Γ. Εισαγωγή στους γράφους. Κωδικός Βιβλίου στον Εύδοξο: 31356.
- Γ. Μανωλόπουλος, Μαθήματα Θεωρίας Γράφων . Κωδικός Βιβλίου στον Εύδοξο: 3472
- Σημειώσεις στη Θεωρία Γραφημάτων, Χάρης Παπαδόπουλος, Πανεπιστήμιο Ιωαννίνων, 2012.
- Θεωρία γραφημάτων με παραδείγματα κ ασκήσεις, Κωδικός Βιβλίου στον Εύδοξο: 31528, Συγγραφείς: ΠΑΠΑΙΩΑΝΝΟΥ.ΑΛΕΞΑΝΔΡΟΣ, Διαθέτης (Εκδότης): ΑΡΗΣ ΣΥΜΕΩΝ.
- Θεωρία και Αλγόριθμοι Γράφων, Κωδικός Βιβλίου στον Εύδοξο: 33134148, Συγγραφείς: Ιωάννης Μανωλόπουλος, Απόστολος Παπαδόπουλος, Κωνσταντίνος Τσίχλας, Διαθέτης (Εκδότης): ΕΚΔΟΣΕΙΣ ΝΕΩΝ ΤΕΧΝΟΛΟΓΙΩΝ ΜΟΝ. ΕΠΕ.

COURSE OUTLINE
MAE747 – LINEAR AND NONLINEAR WAVES

GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="3">School of Science</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="3">Department of Mathematics</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="3">Undergraduate</td></tr>
<tr><td>COURSE CODE</td><td>MAE747</td><td>SEMESTER</td><td>7th</td></tr>
<tr><td>COURSE TITLE</td><td colspan="3">Linear and Nonlinear Waves</td></tr>
<tr><td colspan="2">INDEPENDENT TEACHING ACTIVITIES
if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</td><td>WEEKLY TEACHING HOURS</td><td>CREDITS</td></tr>
<tr><td colspan="2">Lectures</td><td>3</td><td>6</td></tr>
<tr><td colspan="2">Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)</td><td></td><td></td></tr>
<tr><td>COURSE TYPE
general background, special background, specialised general knowledge, skills development</td><td colspan="3">Special Background</td></tr>
<tr><td>PREREQUISITE COURSES</td><td colspan="3"></td></tr>
<tr><td>LANGUAGE OF INSTRUCTION and EXAMINATIONS</td><td colspan="3">Greek</td></tr>
<tr><td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td><td colspan="3">Yes</td></tr>
<tr><td>COURSE WEBSITE (URL)</td><td colspan="3"></td></tr>
</table>

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The study of nonlinear systems has quietly and steadily revolutionized the realm of science over recent years. It is known that for nonlinear systems new structures emerge that have their features and peculiar ways of interacting. Examples of such structures abound in nature and include, amongst others: vortices (like tornadoes), solitons (bits of information used in optical fiber communications, water waves, tsunamis, etc), and chemical reactions. This course is intended as an introduction to the theory and of Nonlinear Waves and their applications. By the end of the course students will be able to:

- highlight the major differences between linear and nonlinear waves and the special features of solitons.
- Solve linear waves equations and understand the concept of a dispersion relation.

- Construct similarity solutions.
- use the inverse scattering transform and to construct analytical solutions.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*

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

SYLLABUS

The linear wave theory, Burgers' equation, the Korteweg-de Vries (KdV) equation, travelling waves and the scattering problem for the KdV equation, the inverse scattering transform and solitons, the nonlinear Schrödinger equation, applications to water waves and optics.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students.*	Yes
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching,*	

Activity	*Semester workload*
Lectures	39
Self study	78
Exercises	33
Course total	**150**

educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Weekly homework • Final project • Final exam

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Solitons: an Introductions, P. G. Drazin and R. S. Johnson, Cambridge University Press, 1989.
- Γ. Δ. Ακρίβης και Ν .Δ. Αλικάκος, Μερικές Διαφορικές Εξισώσεις, Σύγχρονη Εκδοτική, 2012.
- Εφαρμοσμένα Μαθηματικά, D. J. Logan, Πανεπιστημιακές Εκδόσεις Κρήτης, 2010.

COURSE OUTLINE
MAE801 – ASTRONOMY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE801**	**SEMESTER**	8th
COURSE TITLE	**ASTRONOMY**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://ecourse.uoi.gr/course/view.php?id=235		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course introduces students to the basic principles of astronomy. Upon successful completion of this course students should be able to:

- know the physical parameters related to the structure, evolution, and final stages of stars.
- describe the most important features of the Sun and its activity.
- know the most important features of the members of our planetary system.
- ecognize the structure of the Milky Way Galaxy and other galaxies.
- present the up-to-date views about the structure and evolution of the Universe.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these

appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Respect for the natural environment
- Production of free, creative and inductive thinking

SYLLABUS

Mechanisms of emission and absorption of radiation. Radiative transfer in stellar atmospheres. Stellar magnitudes and distances. Stellar spectra and classification, Hertzsprung-Russell diagram. Internal structure, formation and evolution of stars. Final stages of stars: white dwarfs, neutron stars and black holes. The Sun and the solar system. Variable and peculiar stars. Stellar groups and clusters. Interstellar matter. The Milky Way Galaxy. Other galaxies. Cosmology.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face teaching
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students.*	The Moodle e-learning platform is used for the delivery of lecture notes and exercises to the students.
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well*	see table below

Activity	***Semester workload***
Lectures (13X3)	39
Study & analysis of bibliography	90
Non-directed study	18
Examination	3
Course total	**150**

as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examination at the end of semester.

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- "Introduction to Astrophysics", C. E. Alissandrakis, Papazisis Publications, ISBN: 978-960-02-3058-1 (in Greek).
- "Astrophysics, volume I", F. Shu, Crete University Press, ISBN: 978-960-7309-16-7 (in Greek).
- "Astrophysics, volume II", F. Shu, Crete University Press, ISBN: 978-960-7309-17-4 (in Greek).

COURSE OUTLINE
MAE802 – METEOROLOGY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE802**	**SEMESTER**	8th
COURSE TITLE	**METEOROLOGY**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	In the Ioannina University platform e-course		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of the course is to give students the opportunity to be familiar with the basic principles of Meteorology and realize if they are interested in working, studying or doing research on this scientific field in the future. Specifically, after the successful completion of the course, the students will be able to:

- Explain the definitions and the quantitative and qualitative characteristics of the various meteorological parameters.
- Describe and explain the various meteorological phenomena.
- Describe and explain the main measurement techniques in Meteorology and the meteorological instruments.

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology • Working independently • Respect for the natural environment • Production of free, creative and inductive thinking

SYLLABUS

Weather and climate. Composition and vertical structure of the atmosphere. Solar radiation and mechanisms of heat transfer in the atmosphere. Air temperature. Atmospheric pressure. Wind. Large-scale and small-scale circulations in the atmosphere. Atmospheric humidity. Atmospheric stability. Clouds, fog, dew and frost. Precipitation (rain, snow, etc.). Fronts. Atmospheric disturbances. Measurement techniques and meteorological instruments. Fundamental elements of weather analysis and forecasting. Educational visit to the Laboratory of Meteorology of the Physics department and the university meteorological station.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students.*	Asynchronous online learning via Moodle is used for providing the lecture slides and the communication with the students.
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching,*	see table below

Activity	***Semester workload***
Lectures (13X3)	39
Individual study	90
Solving exercises	15
Educational visits	6
Course total	**150**

educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examinations at the end of semester, comprising questions of knowledge and understanding of the course content.

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Aguado E, Burt JE. 2014: Understanding Weather and Climate (7th Edition), Pearson.
- Ahrens CD, Henson P. 2018: Meteorology Today: An Introduction to Weather, Climate and the Environment 12th Edition, Cengage Learning.
- Flocas A. 1997: Meteorology and Climatology courses. Ziti Editions, Thessaloniki (in Greek).
- Sahsamanoglou Ch, Makrogiannis T. 1998: General Meteorology. Ziti Editions, Thessaloniki (in Greek).

COURSE OUTLINE
MAE805 – TEACHING OF MATHEMATICS

GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="3">School of Science</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="3">Department of Mathematics</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="3">Undergraduate</td></tr>
<tr><td>COURSE CODE</td><td>MAE805</td><td>SEMESTER</td><td>8th</td></tr>
<tr><td>COURSE TITLE</td><td colspan="3">TEACHING OF MATHEMATICS</td></tr>
<tr><td colspan="2">INDEPENDENT TEACHING ACTIVITIES
if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</td><td>WEEKLY TEACHING HOURS</td><td>CREDITS</td></tr>
<tr><td colspan="2">Lectures</td><td>3</td><td>6</td></tr>
<tr><td colspan="2">Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)</td><td></td><td></td></tr>
<tr><td>COURSE TYPE
general background, special background, specialised general knowledge, skills development</td><td colspan="3">Skills Development</td></tr>
<tr><td>PREREQUISITE COURSES</td><td colspan="3"></td></tr>
<tr><td>LANGUAGE OF INSTRUCTION and EXAMINATIONS</td><td colspan="3">Greek</td></tr>
<tr><td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td><td colspan="3"></td></tr>
<tr><td>COURSE WEBSITE (URL)</td><td colspan="3"></td></tr>
</table>

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are the acquisition of a theoretical background in the teaching of Mathematics and the development of appropriate skills to organize, implement and evaluate mathematics courses at secondary level.

Having successfully completed the course the students should:

- Know the extend and the distribution of the curriculum in Secondary Education.
- Plan teaching for classes in Secondary Education
- Organize various evaluation tests and activities (written, oral, multiple choice, group activites

e.t.c.)

- Use sources other than school textbooks
- Understand the particular features of each class and taking them into account in the organization of teaching
- Gain teaching experience
- Handle in class problems stemming from students' particularities

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Working independently
- Group activities
- Project planning and management
- Respect for difference and multiculturalism
- Showing social, professional and ethical responsibility and sensitivity to gender issues
- Criticism and self-criticism
- Production of free, creative and inductive thinking

SYLLABUS

Education and its aims. Elements of the history of Mathematics and the development of Mathematical Education. General purposes in the teaching of Mathematics. Philosophy and learning of Mathematics. Models in the teaching of Mathematics. Teaching mathematical concepts and notions. Analysis, Algebra, Geometry. Mathematical courses: programming, planning, preparation, presentation, evaluation. Assessment of teaching: conclusions and perspectives. The organization of Mathematics in Primary and Secondary Education. Curriculums, magazines, competitions.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students.*	Course's site in E-course

<table>
<tr>
<td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.</td>
<td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (13x3)</td><td>39</td></tr>
<tr><td>Study and analysis of bibliography</td><td>36</td></tr>
<tr><td>Presentations</td><td>25</td></tr>
<tr><td>Essay</td><td>25</td></tr>
<tr><td>Group activities</td><td>25</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td>
</tr>
<tr>
<td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure.
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
<td>Language evaluation: Greek

Evaluation based on:
• written essay
• presentation,
• class teaching

Evaluation criteria accessible to students will be posted in E-course.</td>
</tr>
</table>

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Μπάμπης Τουμάσης, Σύγχρονη Διδακτική των Μαθηματικών, Εκδόσεις Gutenberg, Αθήνα 2004
- Θεόδωρος Εξαρχάκος, Διδακτική των Μαθηματικών, Ελληνικά Γράμματα, Αθήνα 1993
- Αθανάσιος Γαγάτσης, Θέματα Διδακτικής των Μαθηματικών, Εκδ. Κυριακίδη, Θεσ/κη 1983
- Morris Kline, Γιατί δεν μπορεί να κάνει πρόσθεση ο Γιάννης, Εκδ. Βάνιας, Θεσ/κη 1993 (Μετάφραση: Β. Τομανάς)

- Related academic journals:

- Περιοδικό της Ε.Μ.Ε. «Ευκλείδης»
- College Mathematical Journal, Amer. Math. Soc.

COURSE OUTLINE
MAE814 - TOPICS IN REAL FUNCTIONS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE814**	**SEMESTER**	8th
COURSE TITLE	**Topics on Real Functions**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The plan of the course is the achievement by the undergraduate student of special theoretical background in the theory of real functions.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Project planning and management

Respect for difference and multiculturalism

Respect for the natural environment

Adapting to new situations *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment*	*Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The objective of the course is the undergraduate student's ability achievement in analysis and synthesis of the basic background in the theory of real functions.	

SYLLABUS

Monotone functions-continuity, functions of bounded variation, Fς and Gd sets, sets of measure zero, Lebesgue's theorem (every monotone function is differentiable almost everywhere), Darboux continuous functions-definitions, properties, equivalent characterizations, criteria, Semicontinuous functions, differentiability of the Riemann integral of a function, Baire classes, Borel measurable functions, analytic sets-characterizations, connections with Borel sets-related theory, Lebesgue and Stieltjes integrals.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	(see table below)
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.*	Written examination at the end of the semester.

Activity	*Semester workload*
Lectures	39
Independent study	78
Exercises solutions	33
Course total	**150**

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- 1 A.C.M. Van Rooij, W.H. Schikhof, A second course on real functions, Cambridge University Press.

COURSE OUTLINE
MAE816 – DIFFERENCE EQUATIONS - DISCRETE MODELS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE816**	**SEMESTER**	8th
COURSE TITLE	**Difference Equations - Discrete Models**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Language of Instruction (lectures): Greek Language of Instruction (activities other than lectures): Greek and English Language of Examinations: Greek and English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	Course description: http://math.uoi.gr (go to: Studies -> UnderGraduate Studies -> Courses) Learning Management System (e.g.: Moodle): http://users.uoi.gr/kmavridi (go to: Courses)		

LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

Learning outcomes according to Bloom Taxonomy:

Remembering:

- The concept of the Difference Operator, the Summation Operator and the Shift Operator.
- The concept of Binomial Coefficient and the Gamma Function.
- The concept of the Generating Function.
- The concept of the Difference Equation.
- The concept of the z-Transformation.
- The concepts of the Stable Fixed Point and the Asymptotically Stable Fixed Point.
- The concepts of Liapunov Function and Strictly Liapunov Function.
- The concept of sensitive dependence on initial conditions.
- The concept of asymptotic relation between functions.
- The concepts of “O-big” and “O-small”.
- The concept of the homogeneous linear Poincare-type equation.
- The concept of the boundary value problem for non-linear equations.
- The concept of Partial Difference Equations.

Comprehension:

- Basic properties of the Difference Operator, the Summation Operator and the Shift Operator.
- Calculation of indefinite sums.
- Solving certain types of linear difference equations.
- Finding fundamental sets of solutions for linear difference equations.
- Using the Casorati determinant in order to solve linear difference equations.
- Using Generating Functions and z-Transformations in order to solve difference equations.
- Linearisation of non-linear difference equations.
- Studying the stability of the solutions of difference equations and the Floquet Theory.
- Studying the stability of non-linear systems of difference equations and chaotic behaviour.
- Asymptotic approximation of sums.
- Green Functions of boundary value problems for difference equations.
- Oscillation of solutions for difference equations.
- Studying the Sturm-Liouville problem.
- Studying boundary value problems for non-linear difference equations.
- Studying partial difference equations.

Applying:

- Studying economy-related real world problems.
- Studying the growth or the decline of populations.
- Studying physics-related real world problems.
- Studying probabilities-related real world problems.
- Studying epidemiology-related real world problems.

Analyzing: (none).
Synthesizing: (none).
Evaluating: Teaching undergraduate and graduate courses.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment*

Adapting to new situations *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Creative, analytical and inductive thinking.
- Required for the creation of new scientific ideas.
- Working independently.
- Working in groups.
- Decision making.

SYLLABUS

The Difference Calculus, Linear difference equations, Stability theory, Asymptotic methods, The Sturm-Liouville problem, Boundary value problems for non-linear difference equations, Partial difference equations.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	• Lectures in class. • Learning Management System (e.g.: Moodle).
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of Learning Management System (e.g.: Moodle), combined with File Sharing and Communication Platform (e.g.: NextCloud) for 1. distributing teaching material, 2. submission of assignments, 3. course announcements, 4. gradebook keeping for all students evaluation procedures, 5. communicating with students. • Use of Web Appointment Scheduling System (e.g.: Easy!Appointments) for organising office appointments. • Use of Google services for submitting anonymous evaluations regarding the teacher.
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art*	see table below

Activity	*Semester workload*
Lectures	39
Study and analysis of bibliography	78
Preparation of assignments and interactive teaching	33
Course total	**150**

workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Language of evaluation: Greek and English. Methods of evaluation: 1. Weekly written assignments. 2. Few number of tests during the semester. 3. Based on their grades in the aforementioned weekly assignments and tests, limited number of students can participate in exams towards the end of the semester, before the beginning of the exams period. 4. In any case, all students can participate in written exams at the end of the semester, during the exams period. The aforementioned information along with all the required details are available through the course's website. The information is explained in detail at the beginning of the semester, as well as, throughout the semester, during the lectures. Reminders are also posted at the beginning of the semester and throughout the semester, through the course's website. Upon request, all the information is provided using email or social networks.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:(see Eudoxus) *- Related academic journals: (see Eudoxus)*

COURSE OUTLINE
MAE817 – CONVEX ANALYSIS

GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="3">School of Science</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="3">Department of Mathematics</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="3">Undergraduate</td></tr>
<tr><td>COURSE CODE</td><td>MAE817</td><td>SEMESTER</td><td>8th</td></tr>
<tr><td>COURSE TITLE</td><td colspan="3">Convex Analysis</td></tr>
<tr><td colspan="2">INDEPENDENT TEACHING ACTIVITIES
if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</td><td>WEEKLY TEACHING HOURS</td><td>CREDITS</td></tr>
<tr><td colspan="2">Lectures</td><td>3</td><td>6</td></tr>
<tr><td colspan="2">Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)</td><td></td><td></td></tr>
<tr><td>COURSE TYPE
general background, special background, specialised general knowledge, skills development</td><td colspan="3">Special Background</td></tr>
<tr><td>PREREQUISITE COURSES</td><td colspan="3"></td></tr>
<tr><td>LANGUAGE OF INSTRUCTION and EXAMINATIONS</td><td colspan="3">Greek</td></tr>
<tr><td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td><td colspan="3">Yes (in English)</td></tr>
<tr><td>COURSE WEBSITE (URL)</td><td colspan="3">In the platform “E-course” of the University of Ioannina</td></tr>
</table>

LEARNING OUTCOMES

<table>
<tr><td>Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
Guidelines for writing Learning Outcomes</td></tr>
<tr><td>The course aims to an introduction to convex analysis at undergraduate level. It is desired for students to understand convex sets with respect to some of their qualitative (from a geometric/combinatorial point of view) and quantitative (e.g. volume, surface area) properties together with the study of the corresponding convex functions.</td></tr>
<tr><td>General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?
Search for, analysis and synthesis of data   Project planning and management</td></tr>
</table>

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

- Working independently
- Team work
- Production of free, creative and inductive thinking
- Production of analytic and synthetic thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Get in touch with specialized knowledge and evolve abilities for comparing, obtaining and evaluating results on the specific area of interest.

SYLLABUS

Basic notions. Convex functions and convex sets. Polytopes. Gauge functions and support functions. The Caratheodory. Radon’s and Helly’s theorems. Minkowski’s First theorem. The Brunn-Minkowski inequality. Mixed volumes. Inequalities of isoperimetric type (e.g. the classical isoperimetric inequality and the Blaschke-Santalo inequality). F. John's Theorem. The reverse isoperimetric inequality.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures/ Class presentations
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of the platform “E-course” of the University of Ioannina
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	see table below

Activity	*Semester workload*
Lectures/Presentations	39
Assignments/Essays	33
Individual study	78
Course total	**150**

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Students' evaluation by the following: • Class presentation – Essays – Assignments • Final Written Examination Evaluation criteria and all steps of the evaluation procedure will be accessible to students through the platform "E-course" of the University of Ioannina.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- R. J. Gardner, Geometric tomography. Second edition.
- R. Tyrel Rockafellar, Convex Analysis.
- R. Schneider, Convex bodies: the Brunn-Minkowski theory. Second expanded edition.
- A. C. Thompson, Minkowski Geometry.
- R. Webster, Convexity.

COURSE OUTLINE
MAE821 – SPECIAL TOPICS IN ALGEBRA

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE821**	**SEMESTER**	8th
COURSE TITLE	**Special topics in Algebra**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

The basic objective of this lecture is the development of Module Theory. Drawing on this the Theoretical Algebra and deepening it, we will study implications of Theory of Groups and Theory of Rings, that have been studied in previous academic years. This subject consists of two parts. In the first part, after a revision of the basic concepts of the Group Theory and of the Ring Theory, we will define in detail the notion of a module. In the second part, through the Decomposition Theorems we will connect Module Theory with relevant objects, as for example that of the finitely generated groups (achieving the full classification of them) and also with objects of Linear Algebra (through Smith Form, Rational Canonical Form, Jordan Canonical Form). The expectations of the students are to understand the concepts, the definitions and the main theorems of this subject.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Work autonomously • work in teams • develop critical thinking skills.

SYLLABUS

- Rings and Ideals
- Principal Ideal Domains and Unique Factorization Domains
- The notion of Module. Module structure and isomorphism theorems
- Finitely generated modules. Free modules
- Annihilator. Product and direct sum of modules
- Fundamental Structure Theorems
- Vector space decomposition Theorems
- Free torsion modules
- Smith Form. Rational Canonical Form. Jordan Canonical Form.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art*	see table below

Activity	***Semester workload***
Lectures/Presentations	39
Autonomous study	111
Course total	**150**

workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Weakly homeworks and written final examination.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- J.Beachy, Introductory lectures on Rings and Modules, LMS, Cambridge University Press,
- (1999).
- D.Dummit, R.M.Foote, Abstract Algebra, 3rd edition, Prentice Hall, (2003).
- N.Jacobson, Basic Algebra I & II, W. H. Freeman and Company, (1985 & 1989).
- S.Lang, Algebra, Graduate Texts in Mathematics, Springer (2002).
- L.Rowen, Ring Theory, Academic Press, 2nd edition (1991).
- Maliakas, Talelli, Modules over P.I.D. Ed.Sofia (in greek) (2009).
- A Beligiannis, An introduction to Algebra, Ed. Kallipos (in greek) (2015).

COURSE OUTLINE
MAE822 – SPECIAL TOPICS IN GEOMETRY

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE822**	**SEMESTER**	8th
COURSE TITLE	**Special Topics in Geometry**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, laboratory exercises		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek, English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes.*
This course introduces the notion of differential forms. The aim of the course is to prove Stokes theorem for manifolds with boundary and to provide applications in differential geometry as well as in other areas of mathematics. The course requires tools from linear algebra, calculus of several variables, topology and elementary differential geometry. On completion of the course the student should be familiar with differential forms and the meaning of Stokes theorem.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these*

appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Working independently • Decision-making • Production of free, creative and inductive thinking • Criticism and self-criticism

SYLLABUS

Differential forms in Euclidean space, line integrals, differentiable manifolds (with or without boundary), integration of differential forms on manifolds, theorem of Stokes and applications, Poincarè lemma, differential geometry of surfaces, structure equations.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study*	(see workload table below)

Activity	*Semester workload*
Lectures (13X3)	39
Working independently	78
Exercises-Homeworks	33
Course total	**150**

according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English) which includes resolving application problems.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- M. do Carmo, Διαφορικές Μορφές, Θεωρία και Εφαρμογές, Prentice-Hall, Πανεπιστημιακές Εκδόσεις Κρήτης, 2010.

COURSE OUTLINE
MAE823 – ALGEBRAIC STRUCTURES II

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE823**	**SEMESTER**	8th
COURSE TITLE	**Algebraic Structures II**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background
PREREQUISITE COURSES	
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://sites.google.com/site/apostolosthomamath/teaching

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes.*

The students will acquire with the successful completion of the course

- the skills to solve equations of small degree,
- the skills to find splitting fields and compute Galois groups,
- understand the problem of solving polynomial equations by radicals,
- understand the impossibility or not of certain constructions by ruler and compass.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
The course aim is for the student to acquire the ability in analysis and synthesis of knowledge in Field Theory and produces free, creative and inductive thinking.

SYLLABUS

- Rings
- Integral Domains, Fields, Homomorphisms and Ideals
- Quotient Rings
- Polynomial Rings over fields
- Prime and Maximal Ideals
- Irreducible Polynomials
- The classical methods of solving polynomial equations
- Splitting fields
- The Galois Group
- Roots of unity
- Solvability by Radicals
- Independence of characters
- Galois extensions
- The Fundamental Theorem of Galois Theory
- Discriminants
- Polynomials of degree ≤ 4 and Galois Groups
- Ruler and Compass constructions

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	

<table>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td>
<td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (13X3)</td><td>39</td></tr>
<tr><td>Working independently</td><td>78</td></tr>
<tr><td>Exercises-Homeworks</td><td>33</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure.
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
<td>Final written exam in Greek (in case of Erasmus students in English) which includes resolving application problems.</td></tr>
</table>

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- **S. Andreadakis**: "Galois Theory", (Greek), Symmetria Publishing Company, (1999).
- **M. Holz:** "Repetition in Algebra", Greek Edition, Symmetria Publishing Company, (2015).
- **J. Rotman**: "Galois Theory", Greek edition, Leader Books, (2000).
- **Th. Theochari-Apostolidou and C. M. A. Charalambous**: "Galois Theory", (Greek), Kallipos Publishing (2015).

COURSE OUTLINE
MAE832 - STATISTICAL DATA ANALYSIS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE832**	**SEMESTER**	8th
COURSE TITLE	**Statistical Data Analysis**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures-Laboratory		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English, reading Course)		
COURSE WEBSITE (URL)	http://users.uoi.gr/abatsidis/832.html		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of this course is the implementation of the statistical theory which was developed in "633-Statistical Inference" and "733-Regression and Analysis of Variance" in analyzing (statistical) data by using statistical packages (for instance JMP, SPSS, S-Plus). At the end of the course the student should be able to:

a) enter data on the computer

b) conduct descriptive statistical analysis that summarizes the available data

c) perform basic data analysis (testing for outliers and normality, basic hypothesis testing with dependent and independent samples, one way anova)

d) adjust linear models, mainly simple regression, controlling on whether the assumptions of the model are violated or not

e) present and interpret the results of the above analysis.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Working independently • Decision-making • Production of free, creative and inductive thinking • Criticism and self-criticism.

SYLLABUS

The implementation of the statistical theory which was developed in "633-Statistical Inference" and "733-Regression and Analysis of Variance" in analyzing data using statistical packages (for instance JMP, SPSS, S-Plus) is the main aim of the course. In particular, the following subjects are discussed: testing hypotheses, simple and multiple linear regression analysis, one way and two way Anova (with and without interaction). The course is laboratorial.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in communication with students
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	(see table below)

Activity	*Semester workload*
Lectures	39
Working independently	78
Exercises-Homework	33
Course total	**150**

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English) which concentrates on the solution of problems which are motivated by the main themes of the course.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Books in English:

- Carver and Nash (2006). Doing data analysis with SPSS version 14.
- Field A. (2005). Discovering Statistics using SPSS. Sage Publications.
- Marques de Sa (2007). Applied Statistics using SPSS, Statistica, Matlab and R. Springer.
- Coakes and Steed (1999).SPSS: Analysis Without Anguish

Books in Greek:

- Απόστολος Μπατσίδης (2014). Στατιστική Ανάλυση Δεδομένων με το S.P.S.S. (διαθέσιμες στην ιστοσελίδα του μαθήματος καθώς και διδακτικό υλικό).

COURSE OUTLINE
MAE835 – NON PARAMETRIC STATISTICS - CATEGORICAL DATA ANALYSIS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE835**	**SEMESTER**	8th
COURSE TITLE	**Non Parametric Statistics- Categorical Data Analysis**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English, reading Course)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The aim of this course is to introduce students to the methods of Non parametric techniques (goodness-of-fit tests, ranks etc) as well as their application to real practical problems. At the end of the course the student should have understood the basic methods of Non-Parametric Statistics and Categorical Data, knowing when to adopt and how to apply them for analyzing data.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*

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

- Working independently
- Decision-making
- Production of free, creative and inductive thinking
- Criticism and self-criticism.

SYLLABUS

Empirical distribution function, Goodness of fit tests: Kolmogorov-Smirnov test, Chi-square, Runs test, Sign tests, Wilcoxon - Mann – Whitney test, Kruskal – Wallis test. Correlation coefficients. Categorical Variables. Statistical inference for binomial and multinomial parameters, Contingency Tables, Comparing two proportions, Testing: independence, Symmetry, Homogeneity. 2 x 2 Tables (Exact Fisher's test, McNemar's test). Applications. Loglinear models.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study*	see table below

Activity	***Semester workload***
Lectures (13X3)	39
Working independently	78
Exercises-Homework	33
Course total	**150**

according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English).

ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

Texts in English:

- Agresti, A. (2007). An Introduction to Categorical Data Analysis. 2nd ed. ISBN: 978- 0-470-38800-6. Wiley
- Conover, W. J. (1999). Practical Nonparametric Statistics. 3rd ed. ISBN: 978-0-471- 16068-7. John Wiley & Sons

Texts in Greek:

- Ζωγράφος, Κ. (2009). Κατηγορικά Δεδομένα. Πανεπιστήμιο Ιωαννίνων.
- Μπατσίδης, Α. (2010). Εισαγωγή στη Μη Παραμετρική Στατιστική. Πανεπιστήμιο Ιωαννίνων

COURSE OUTLINE
MAE836 - COMPUTATIONAL STATISTICS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE836**	**SEMESTER**	8th
COURSE TITLE	**Computational Statistics**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures-Laboratory		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English, reading Course)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
Students completing this course should be able to: • Apply the most common methods of computational statistics • generate random numbers from discrete and continuous distributions • use R and other statistical software to perform statistical analysis • use different methods to solve an optimization problem.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*

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

- Working independently
- Decision-making
- Production of free, creative and inductive thinking
- Criticism and self-criticism.

SYLLABUS

Using R the following topics will be discussed: Generation of random numbers from discrete and continuous distributions. Monte Carlo integration. Using simulation techniques to visualize classical results of statistical inference via simulated data (asymptotic normality of mean, power of a test etc). Density Estimation and Applications (Kernel density estimation). Methods of Resampling ς (Jackknife και Bootstrap). Numerical maximization techniques (Newton-Raphson, Fisher scoring, expectation-maximization [EM]).

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well*	see table below

Activity	***Semester workload***
Lectures	39
Working independently	78
Exercises-Homework	33
Course total	**150**

as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English) which concentrates on the solution of problems which are motivated by the main themes of the course.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Books in English:

- Davison, A. C., Hinkley, D. V., Bootstrap methods and their application. Cambridge University Press 1997.
- Rizzo, M. L., Statistical computing with R. Chapman & Hall/CRC 2007.
- Robert, C. P., Casella, G., Introducing Monte Carlo methods with R. Springer Verlag 2009

Books in Greek:

- Φουσκάκης Δ. Ανάλυση Δεδομένων με χρήση της R, Εκδότης Τσότρας.

COURSE OUTLINE
MAE837 – SPECIAL TOPICS IN STATISTICS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE837**	**SEMESTER**	8th
COURSE TITLE	**Special Topics in Statistics**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English, reading Course)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
Students will become familiar with the themes in question and develop knowledge of statistical methods, and will also learn how the methodology becomes relevant in certain application areas. Students will learn a specialized field of statistics not covered by any ordinary course.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data*   *Project planning and management*

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

- Working independently
- Decision-making
- Production of free, creative and inductive thinking
- Criticism and self-criticism.

SYLLABUS

The precise contents of this course may vary from occasion to occasion, but will consist of selected themes of contemporary research interest in statistics methodology, depending on both demands from students and the availability of appropriate course leaders. Examples include parametric lifetime modeling, experimental design, extreme value statistics, advanced stochastic simulation, graphical modeling, statistics quality control etc. The course will be of interest to students who want to develop their basic knowledge of statistics methodology. See the specific semester page for a more detailed description of the course.

For the next academic year the syllabus of the course is the following:

Multivariate distributions: basic properties. Multivariate normal distribution: properties and estimation. Brief review of multivariate methods of statistical analysis: Principal Components, Factor Analysis, MANOVA, Discriminant Analysis.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom (face-to-face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay*	see table below

Activity	*Semester workload*
Lectures	39
Working independently	78
Exercises-Homework	33
Course total	**150**

writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek (in case of Erasmus students in English) which concentrates on the solution of problems which are motivated by the main themes of the course.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Since the precise contents of this course may vary from occasion to occasion, depending on both demands from students and the availability of instructors, for the bibliography see the specific semester page. For the next academic year 2018-2019 the bibliography is:

Books in Greek:

- Καρλής Δημήτρης (2005). Πολυμεταβλητή στατιστική ανάλυση. Εκδόσεις Σταμούλη.
- DAVID J. BARTHOLOMEW, FIONA STEELE, IRINI MOUSTAKI, JANE I. GALBRAITH (2011). Ανάλυση πολυμεταβλητών τεχνικών στις κοινωνικές επιστήμες. Εκδόσεις Κλειδάριθμος ΕΠΕ.

COURSE OUTLINE
MAE840 – PARALLEL ALGORITHMS AND SYSTEMS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE840**	**SEMESTER**	8th
COURSE TITLE	**Parallel Algorithms and Systems**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures-Laboratory		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES	Introduction to programming, Introduction to Computers, Database Systems and Web applications development		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes(in English)		
COURSE WEBSITE (URL)	https://spooky.math.uoi.gr/eclass		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Students knowledge acquisition of:

- Parallel algorithmic methods, multitasking programming, thread programming, resources contention/congestion and contention/congestion avoidance mechanisms
- Understanding of the basic functional parts of a parallel and a distributed system.
- Understanding of the basic concepts and techniques / programming, communication, and transparency techniques used in both parallel and distributed systems.
- Programming parallel tasks using parallel programming libraries such as OpenMP and distributed programming tools such as MPI.

Parallel algorithms, Parallel architectures, Parallel algorithm development, Parallel Selection, Parallel Merge, Parallel Classification, Parallel Search, Parallel Algorithms of Computational Geometry. Parallel iterative methods for solving Linear problems.
Parallel and Distributed Systems and Architectures. Performance of Parallel and Distributed Systems and Applications.
Threading / multitasking and programming of parallel and distributed algorithms using OpenMP and MPI.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Data search, analysis and synthesis using Information Technologies
- Decision making
- Project design and implementation
- Working independently

SYLLABUS

1. Historical review of parallel and distributed processing.
Von Neumann model. Flynn categorization. Tubing. Multiprocessors, Multi-computers.
2. Distributed and Shared Memory Systems. Memory architectures for single and non-unified access time.
Performance calculations and metrics. System scalability, partitioning and optimization. Parallel computer interface networks.
3. Law of Grosch, of Amdahl, of Gustafson Barsis. Design of parallel applications.
4. Program parallelization - MPI. Synchronization. Dependency charts, shared resources and racing conditions. Scheduling. Shared Memory Affinity. MESI. Parallel Processing using parallella FPGA cores.
5. Models and process communication mechanisms. Vector Processing. Arrays and computational grid. Examples of application parallelization. Synchronization issues

Course laboratory part
1. Introductory programming concepts using gcc. Pointers, classes, dynamic structures. Creating processes in Linux, separating user-space and kernel-space concepts, parenting processes and parent-child relationships, Process Management.
2. Containers, Templates, STL (C++ standard templates library).
3. Introduction to Boost and advanced C ++ aspects.
4. Introduction to C ++ Armadilo

5. Process intercommunication. Static memory areas, pipelines, shared memory areas, process signalling.
6. Threads creation and thread management. shared thread memory areas, critical areas, producer-consumer model, threads signalling.
7. Thread Management and Synchronization, critical areas protection using mutex locks and semaphores. Presentation of conditional execution threads and sync barriers.
8. Introduction to MPI, MPI settings, MPI key features presentation, preliminary MPI programs.
9. Presentation of basic modern methods of sending and receiving messages in MPI. Presentation of asynchronous upload methods. Examples.
10. Using Gather-Scatter-Reduce-Broadcast Collective Methods and Examples.
11. Basic structures for organizing distributed programs. Examples of distributed calculations. Advanced data types using MPI. Creating 12. Complex Data Structures with MPI And Sending Data Structure Messages.
13. Parallel programming OpenMP and Epiphany-SDK, BSP.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Classroom
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Micro-computers Laboratory
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	see workload table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions,*	Using new ICT and metrics of the asynchronous e-learning platform (30%) Examination of laboratory exercises (20%) Semester written examination (50%)

Activity	*Semester workload*
Lectures	39
Working Independently	78
Exercises-Homework	33
Course total	**150**

problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Parallel Scientific Computing in C++ and MPI: A Seamless Approach to Parallel Algorithms and their Implementation, G.M. Karniadakis and R.M. Kirby, 2003, Cambridge University press, ISBN: 0-521-81754-4
- Using OpenMP, Portable Shared Memory Parallel Programming., B. Chapman, G. Jost and R. Pas, 2008, MIT press, ISBN: 9780262533027
- Learning Boost C++ libraries, A. Mukherjee, 2015, PACKT, ISBN:978-1-78355-121-7
- Boost C++ Application Development Cookbook - Second Edition: Recipes to simplify your application development, 2nd Edition, A. Polukhin, 2017, PACKT, ISBN:978-1-78728-224-7
- C++17 STL Cookbook, J. Galowicz, PACKT,978-1-78712-049-5, 2017

COURSE OUTLINE
MAE841 – SPECIAL TOPICS IN COMPUTER SCIENCE

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE841**	**SEMESTER**	8th
COURSE TITLE	**Special Topics in Computer Science**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
lectures, exercises, tutorials		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The aim of the course is to specialize in areas covered by Computer Science in applied fields. It provides background in data and information management. The specialization covers cognitive domains such as Databases, Machine Learning, Artificial Intelligence, Data Mining, etc. It also addresses all issues related to the design and optimization of computer hardware and software. This includes cognitive areas such as Programming Languages and their Implementation, Compilers, Hardware Design, Computer Architecture, Operating Systems, Distributed Systems, and more. The students of the course are expected to deepen in modern data processing techniques both theoretically and practically, while also acquiring a multifaceted knowledge of the principles of computer system design and programming. The course includes individual exercises, summary writing projects and presentation of relevant research papers.

The material will be adapted and specialized according to the necessary developments and requirements.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology • Working independently • Team work • Project planning and management.

SYLLABUS

The main objective of the course is to specialize in areas covered by Computer Science in applied fields such as:

- Data Mining
- Artificial Intelligence
- Database Systems
- Security of Information Systems
- Distributed Systems
- Mobile and Wireless Networks
- Pattern Recognition
- Machine Learning
- Signal Processing

The specialized subject will be adapted and specialized according to the necessary developments and requirements.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of projector and interactive board during lectures.

<table>
<tr><td>Use of ICT in teaching, laboratory education, communication with students</td><td></td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Working independently</td><td>78</td></tr>
<tr><td>Exercises – Homework</td><td>33</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure.
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>
Final written examination (70%)
Exercises / Homework (30%)
</td></tr>
</table>

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Bibliography (indicative)

- Evans Alan, Martin Kendall, Poatsy Mary Anne, Introduction to Computer Science: Theory and Practice, Κωδικός Βιβλίου στον Εύδοξο: 41955480, 2014.
- Παπαδόπουλος, Α., Μανωλόπουλος, Ι., Τσίχλας, Κ. 2015. Εισαγωγή στην Ανάκτηση Πληροφορίας, Αποθετήριο «Κάλλιπος», 2015.
- Παρασκευάς, Μιχαήλ, Ειδικά θέματα εφαρμογών της Κοινωνίας της Πληροφορίας, Αποθετήριο «Κάλλιπος», 2015.
- Δημακόπουλος, Β. Εισαγωγή: Παράλληλα Συστήματα και Προγραμματισμός, Αποθετήριο «Κάλλιπος», 2015.

COURSE OUTLINE
MAE842 – SPECIAL TOPICS IN NUMERICAL ANALYSIS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE842**	**SEMESTER**	8th
COURSE TITLE	**Special Topics in Numerical Analysis**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
After successful end of this course, students will be able to: • thoroughly understand problems arising from applications' • be aware to analyze the problem and chose the appropriate numerical method for solving it, • solve the problem by implementing the methods with programs on the computer.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data   Project planning and management*

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

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Criticism and self-criticism
- Production of free, creative and inductive thinking

SYLLABUS

Special subjects of Numerical Linear Algebra coming from Applications. Special subjects of Numerical Solution of Differential Equations coming from Applications.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	In the class
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	see table below

Activity	***Semester workload***
Lectures	39
Study and analysis of bibliografy	104
Exercises-Homeworks	33
Course total	**150**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examination, Project.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Lecture notes,
- Special scientific papers,
- Special books from the library and from the web.

COURSE OUTLINE
MAE843 – SPECIAL TOPICS IN APPLIED MATHEMATICS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE843**	**SEMESTER**	8th
COURSE TITLE	**Special Topics in Applied Mathematics**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Introduction to computational or theoretical research on acceptable applied mathematics problems and supervision of reading on topics not covered by regular courses of instruction.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
	Respect for difference and multiculturalism
	Respect for the natural environment
Adapting to new situations	*Showing social, professional and ethical responsibility and*

Decision-making *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*

- Adapting to new situations
- Decision-making
- Working independently
- Team work

SYLLABUS

Depending on the students interests and Instructor availability.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of computer (Mechanics) lab
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	see table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or*	• Weekly homework • Final project • Final exam

Activity	*Semester workload*
Lectures	39
Self study	78
Exercises	33
Course total	**150**

conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

COURSE OUTLINE
MAE844 – ALGORITHM ENGINEERING

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE844**	**SEMESTER**	8th
COURSE TITLE	**Algorithm Engineering**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
lectures, laboratory exercises, tutorials, quiz		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

This course aims at introducing to students the concepts , techniques, properties, developments and applications of basic and advanced algorithms and data structures.
Software development and software libraries that allow to easily develop and evaluate experimentally algorithms. Methodologies related to experimental research of efficient algorithms and data structures.
After successfully passing this course the students will be able to:
- Understand basic algorithmic techniques
- Analyze complex algorithms
- Design and develop new algorithmic tools for experimental evaluation

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology • Working independently • Team work • Project planning and management

SYLLABUS

- Introduction to algorithm engineering
- Methodology of Algorithm Engineering: motivation, applications, software systems
- System checking
- Software reliability and correctness
- STL and Generalized programming
- Experimental evaluation of algorithms

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of projector and interactive board during lectures. • Course website maintenance. Announcements and posting of teaching material (lecture slides and notes, programs). • Announcement of assessment marks via the ecourse platform by UOI.
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay*	see table below

Activity	***Semester workload***
Lectures	39
Working independently	78
Team work	33
Course total	**150**

writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Final written examination (70%) • Exercises (30%)

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- [K. Mehlhorn and S. Naeher, LEDA: A platform for combinatorial and geometric computing, Cambridge University Press, 1999.
- M. Mueller-Hannemanni and S. Schirra, Algorithm Engineering - Bridging the Gap between Algorithm Theory and Practice, Springer 2010.
- C.C. McGeoch, A Guide to Experimental Algorithmics, Cambridge University Press, 2012.
- J. Siek, L.Q. Lee, and A. Lumsdaine, The Boost Graph Library, Addison-Wesley, 2002.
- M.A. Weiss, Data structures and problem solving with C++, 2nd Edition, Addison-Wesley, 2000.

COURSE OUTLINE
MAE845 – INTRODUCTION TO NATURAL LANGUAGES PROCESSING

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE845**	**SEMESTER**	8th
COURSE TITLE	**Introduction to Natural Language Processing**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://nlampp-lab.uoi.gr/lab/		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The goal of this course is the deeper understanding of Natural Language Processing (NLP). During the course a detailed examination of the following topics are done:

- A historical retrospection of Language Technology evolution
- The goal of NLP and its Applications
- The NLP levels. Language Processors such as recognition machines, transducers, parsers and generators
- The language as a rule based system. Language Understanding as process
- NLP Resources for parsing, such as Data Base, Knowledge Base, Data Structure, Algorithms and Expert Systems

- Fundamental parsing strategies concerning context free grammars.
- Fundamental Methods of Computational Morphology, Computational Semantics and NLP. Implementations-Applications

After completing the course the student can handle:
- theoretical documentation of problems
- solving exercises
- tracking applications

which related to NLP different topics.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Handle new problems
- Decision making
- Implementation- Consolidation

SYLLABUS

- A historical retrospection of Language Technology evolution
- The goal of NLP and its Applications
- The NLP levels. Language Processors such as recognition machines, transducers, parsers and generators
- The language as a rule based system. Language Understanding as process
- NLP Resources for parsing, such as Data Base, Knowledge Base, Data Structure, Algorithms and Expert Systems
- Fundamental parsing strategies concerning context free grammars.
- Fundamental Methods of Computational Morphology, Computational Semantics and NLP. Implementations-Applications

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face,* *Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	

Use of ICT in teaching, laboratory education, communication with students.	Yes , Use of Natural Language and Mathematical Problems Processing Laboratory
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	see table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Final test

Activity	***Semester workload***
Lectures	39
Self study	78
Exercises	33
Course total	**150**

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Mitkov Ruslan, The Oxford Handbook of Computational Linguistics. ISBN 0-19-823882
- Jurafsky Daniel & Martin H. James, Speech and Language Processing - An Introduction to Ntural Language Proocessing, Computational Linguistics and Speech Recognition. ISBN 0-13-095069-6
- ALLEN James, Natural Language Understanding. ISBN 0-8053-0334-0,
- Natural Language Generation ed. by Gerard Kempen. ISBN 90-247-3558-0
- Professor’s Notes.

COURSE OUTLINE
MAE846 – INTRODUCTION TO EXPERT SYSTEMS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE846**	**SEMESTER**	8th
COURSE TITLE	**Introduction to Expert Systems**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES	Logic Programming, Data Structure		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.
Consult Appendix A
- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The goal of this course is the deeper understanding of PROLOG. During the course a detailed examination of the following topics are done:
- Procedural and Declarative Programming
- Logic Programming a version of Declarative Programming
- The programming language PROLOG (PROLOG programs syntax, Lists, Operators, Arithmetic, Backtracking control, The negation in PROLOG, Recursive predicates, Data Structure manipulation, PROLOG implementation to searching problems, symbolic processing, natural language understanding and metaprogramming)
- Logic Programming Theory
- Logic Programming under restrictions
- Logic Programming systems implementation technics

- Parallel Logic Programming
- Logic Programming for knowledge representation.

After completing the course the student can handle:

- theoretical documentation of problems
- solving exercises
- implementations-applications

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Applications
- Implementation- Consolidation

SYLLABUS

- IIntroduction to Expert Systems
- Main Features of Expert Systems, classic examples
- Knowledge acquisition and verification, knowledge representation, inference and interpretation, consistency and uncertainties.
- Inference techniques
- Rule-based forward chaining Expert Systems
- Rule-based backward chaining Expert Systems
- Rule-based Expert Systems
- Expert Systems tools
- Users Interface
- Machine learning, decision making machines, Expert Systems examples.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Yes , Use of Natural Language and Mathematical Problems Processing Laboratory

TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	(see workload table below)
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Final test

Activity	***Semester workload***
Lectures	39
Self study	78
Exercises	33
Course total	**150**

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Γεώργιος Ι. Δουκίδης, Μάριος Κ. Αγγελίδης, “ Έμπειρα συστήματα, τεχνητή νοημοσύνη και LISP”, ISBN 960-08-0004-9, ISBN-13 978-960-08-0004-3
- Σπύρος Τζαφέστας, “ΕΜΠΕΙΡΑ ΣΥΣΤΗΜΑΤΑ ΚΑΙ ΕΦΑΡΜΟΓΕΣ”, ISBN: - (Κωδικός Βιβλίου στον Εύδοξο: 89871)
- Παναγιωτόπουλος Ιωάννης - Χρήστος Π., “Νέες Μορφές Τεχνολογίας - Γενικευμένα Αυτόματα Συστήματα - Έμπειρα Συστήματα Turbo Prolog”

COURSE OUTLINE
MAE847 – FLUID MECHANICS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE847**	**SEMESTER**	8th
COURSE TITLE	**Fluid Mechanics**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	http://users.uoi.gr/mxenos http://www.math.upatras.gr/~maik/RM.html		

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The course is an introduction to the basic analytic and numerical methods of Fluid Mechanics and Applied Mathematics. The objectives of the course are: • Development of the theoretical background in matters relating to Fluid Mechanics. • Ability of the student to apply the basic concepts of fluid mechanics. • Upon completion of this course the student will be able to solve with analytical and approximate mathematical methods simple problems of Fluid Mechanics and deepen further understanding of such methods.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims to enable the undergraduate students to develop basic knowledge of Fluid Mechanics and in general of Applied Mathematics. The student will be able to cope with problems of Applied Mathematics giving the opportunity to work in an international multidisciplinary environment.	

SYLLABUS

Physical properties of fluids, Static of fluids, Kinematics of fluids, Conservation of mass - continuity equation), Stream function, Differential equations of motion for ideal fluids - Euler equations, Differential equations of motion for viscous fluids - Navier-Stokes equations, Applications of Fluid Mechanics.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	In class
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of computer (Mechanics) lab
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each*	see table below

Activity	*Semester workload*
Lectures	39
Study of theory	78
Home exercises	33
Total	**150**

learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Weekly assignments • Final project • Written examination at the end of the semester

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Fluid Mechanics, Goulas A., 1st Edition, 1986 (in Greek)
- Fluid Mechanics, Volume 1, A. Papaioanou, 2nd Edition, 2001 (in Greek)
- Applied Fluid Mechanics, D.G. Papanikas, 4th Edition, 2010 (in Greek)
- Computational Fluid Mechanics, I. Soulis, 1st Edition, 2008 (in Greek).

COURSE OUTLINE
MAE848 – SCIENTIFIC COMPUTING

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE848**	**SEMESTER**	8th
COURSE TITLE	**Scientific Computing**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES			
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
In most scientific disciplines, the integration of computers has defined new directions to perform research and has offered unprecedented potential to solve complicated problems. Combined with theory and experimentation, computational analysis is nowadays considered an integral part of science and research. The main objective of the course is to familiarize the student with computational techniques that find application in the solution of ordinary and partial differential equations. In the context of this laboratory course, the student will gain access to the programming languages Matlab/Octave and Python, which are widely used to perform scientific calculations. Computational methods to be developed and implemented in PCs will significantly increase the skills and prospects of integrating graduates into the modern scientific and work environment. Starting from the mathematical

modeling of problems of Mechanics and Applied Mathematics in general, and by synthesizing information from numerical analysis and numerical solution of ordinary and partial differential equations, students will acquire crucial knowledge in solving mathematical problems by computational means.
Specifically, the objectives of the course are:

- Familiarity with the Matlab/Octave and Python programming languages to implement numerical methods, solve mathematical problems and graphically design the numerical results
- Apply numerical derivation using the Finite Difference method
- Analysis of the numerical schemes resulting from the Finite Difference method
- Solving ordinary differential equations using one-step and multi-step methods
- Solving parabolic and elliptic Partial Differential Equations with the Finite Difference Method
- Theoretical analysis of the Finite Element method
- Solving parabolic and elliptic Partial Differential Equations with the Finite Element method.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

The course aims to enable the student to:

- Search, analyze and synthesize data and information, using the available technologies
- Work autonomously
- Work in a team
- Promote free, creative and inductive thinking.

SYLLABUS

- Initial Value Problems
- Boundary Value Problems
- Finite Difference method
- Equations of Difference
- Shooting methods and Method of undetermined coefficients
- One-step Methods (Euler, Taylor, Runge-Kutta)
- Multi-step Methods (Adams-Bashforth, Adams-Moulton, Predictor-Corrector)
- Finite Element Method (Galerkin).

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	In the laboratory
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of scientific computing software packages
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	see table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure. Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other. Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Weekly assignments • Final project • Written examination at the end of the semester

Activity	***Semester workload***
Lectures	39
Study of bibliography	39
Laboratory exercises	39
Home exercises (project)	33
Total	**150**

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- -Numerical Methods for Ordinary Differential Equations, 2nd Edition, G.D. Akrivis, V.A. Dougalis, 2012 (in Greek).
- A Primer on Scientific Programming with Python, H. P. Langtangen, Springer-Verlag Berlin

Heidelberg, 5th Edition, 2016.

- Programming for Computations- MATLAB/Octave, S. Linge, H. P. Langtangen, Springer International Publishing, 2016 (in Greek).
- The Mathematical Theory of Finite Element Method, S. C. Brenner, L. R. Scott, Springer-Verlag, New York, 2008.
- Automated Solution of Differential Equations by the Finite Element Method, A. Logg, K.-A. Mardal, G. N. Wells, Springer-Verlag Berlin Heidelberg, 2012.

COURSE OUTLINE
MAE849 – CALCULUS OF VARIATIONS

GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Mathematics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**MAE849**	**SEMESTER**	8th
COURSE TITLE	**Calculus of Variations**		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d)			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES	Classical Mechanics		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Calculus of Variations deals with optimisation problems where the variables, instead of being finite dimensional as in ordinary calculus, are functions. This course treats the foundations of calculus of variations and gives examples on some (classical and modern) physical applications. After successfully completing the course, the students should be able to:

- give an account of the foundations of calculus of variations and of its applications in mathematics and physics.
- describe the brachistochrone problem mathematically and solve it.
- solve isoperimetric problems of standard type.
- solve simple initial and boundary value problems by using several variable calculus.
- formulate maximum principles for various equations.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology. • Adapting to new situations. • Decision-making.

SYLLABUS

The Euler–Lagrange equation. The brachistochrone problem. Minimal surfaces of revolution. The isoperimetric problem. Fermat’s principle (geometric optics). Hamilton’s principle. The principle of least action. The Euler–Lagrange equation for several independent variables. Applications: Minimal surfaces, vibrating strings and membranes, eigenfunction expansions, Quantum mechanics: the Schrödinger equation, Noether’s theorem, Ritz optimization, the maximum principle.

TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Yes
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	

Activity	*Semester workload*
Lectures	39
Self study	78
Exercises	33
Course total	**150**

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure.* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other.* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Weekly homework • Final project • Final exam

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Calculus of Variations, I. M. Gelfand and S. V. Fomin, Dover Publications, 2000.
- Εφαρμοσμένα Μαθηματικά, D. J. Logan, Πανεπιστημιακές Εκδόσεις Κρήτης, 2010.
- Θεωρητική Μηχανική, Π. Ιωάννου και Θ. Αποστολάτος, ΕΚΠΑ, 2007.