■ CC12 - Linear Algebra I

GENERAL

SCHOOL	SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC12	**SEMESTER**	A
COURSE TITLE	LINEAR ALGEBRA I		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	7

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
After the successful completion of the course, the students: • will know the calculus of matrices, will be able to calculate the determinant of a square matrix and the rank of a matrix, • will be able to solve linear systems, • will understand and use notions of a vector space and its base/dimension,

- will be able to recognize if a mapping is linear and to find its basic characteristics (kernel, image, representation matrix).

General Competencies

- Connecting prior knowledge to Linear Algebra concepts.
- Promotion of inductive thinking.

CONTENT OF THE COURSE

Matrices. Special types of matrices. Operations with matrices.
Calculation of the determinant of a square matrix, properties of determinants. The rank of matrix. Inverse matrix.

Linear systems of equations.

Vector spaces, subspaces, linear span. Linear Independence and Dependence. Bases and dimension.

Linear transformations. Kernel, image, matrix and rank of a linear mapping. The isomorphism between vector spaces. Similar matrices.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	e-Lectures. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours
Projects	43 hours
Individual Study	80 hours
Course Total (25 hours per ECTS)	175 hours

STUDENT EVALUATION	Optional projects during the whole semester, with presentations. (bonus to the final grading) Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. Linear Algebra, Theochari-Apostolidi Theodora, Charalambous Chara, Vavatsoulas Charilaos, Publications Tziola & Sons S.A. (2017). (Greek)
2. An Introduction to Linear Algebra, Varsos Dimitris, Deriziotis Dimitris, Emmanouil Giannis, Maliakas Michalis, Melas Antonis, Talelli Olympia, Publications Sophia (2012). (Greek)
3. Linear algebra with Applications, Holt Jeffrey, Publications Gutenberg (2023). (Greek)
4. Linear Algebra and Applications, Gilbert Strang, Publications University Publications of Crete (2021). (Greek)
5. Introduction to Linear Algebra, Papistas Athanasios, Publications Tziola & Sons S.A. (2019). (Greek)

■ CC13 - Introduction to Computers

GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC13	**SEMESTER**	A
COURSE TITLE	INTRODUCTION TO COMPUTERS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	2	7
Computer-Lab	2	

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes

After the successful completion of the course, the students:

- will be able to know the basic notions of computers,
- will be able to recognize and evaluate the technical characteristics of devices,
- will be able to compute various quantities related to memory capacity, data transfer speed and other technical quantities,
- will be able to evaluate and conclude the appropriateness of certain provisions and applications,
- will be able to install various operating systems on a PC,
- will be able to create documents and presentations with LaTeX.

General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Individual work.
- Promotion of free, creative and inductive thinking.
- Generating new research ideas.

CONTENT OF THE COURSE

Basic notions, the meaning of information, calculations and auxiliary means, historical development of Computer Science, numbering systems, coding of information, introduction to algebra Boole and basic logic circuits, the computer hardware, description and analysis of various structural elements that make up a computer, computer peripherals, computer organization, computer arithmetic, processor structure and function, computer memory and its organization. Algorithms, programs and programming, operating systems, data processing, computer networks, internet, information systems and applications. In detail, the sections are:

- Introduction to numerical systems.
- Number representation and codes.
- Arithmetic on the computer.
- Boolean algebra, logic gates.
- Functional structure of computer, basic unit.
- Memory in the computer, memory organization, peripheral memory.
- Computer assembly.
- Peripheral devices.
- Software, Operating systems.
- Installation of operating systems on PCs.
- Digitalization. The concept of file, types of files.
- Computer networks and communications.
- Internet.

- Introduction to LaTeX installation and document creation, document structure. δομή εγγράφου, τύποι εγγράφου. Design and layout. Writing mathematics, equations, arrays, tables. Bibliography, Presentations (beamer)

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom and computer-lab.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Laboratory teaching.
TEACHING ORGANIZATION	**Activity** / **Semester Workload** Lectures — 26 hours Individual Study — 123 hours Laboratory Exercise — 26 hours Course Total (25 hours per ECTS) — 175 hours
STUDENT EVALUATION	Approximately in the middle of the semester, an intermediate exam (progress) will take place, which will participate with a percentage of 30% in the formation of the final grade. The exam at the end of the semester will contribute 40% to the final grade. In the laboratory part of the course there will be an exam using a specialized software which will participate with a percentage of around 20% in the formation of the final grade, while there will also be a written exam, with multiple choice questions, which will participate with a percentage of 10% in the formation of the final grade.

RECOMMENDED BIBLIOGRAPHY

1. Garmpis Aristogiannis & Fotiadis Dimitrios. (2015). Introduction to Computers and Informatics. Publications Arakynthos. (Greek)
2. Evans, Alan, & Kendall, Martin & Poatsy, Mary Anne. (2018). Introduction to Informatics (2nd edition). Publications Kritiki S.A. (Greek)

■ CC14 - Fundamental Notions of Mathematics

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC14	**SEMESTER**	A
COURSE TITLE	FUNDAMENTAL NOTIONS OF MATHEMATICS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	5	8

COURSE TYPE	General Background
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the students will be in position to: • know the basic notions of set theory (operation of sets and properties), along with the concepts of Cartesian product, set of sets, cover and partition, • know the concept of relations and their properties, the concept of composition of relations, along with the notions of equivalencies, orders and bounded sets (supremum, infimum), • know the basic notions of functions, one-to-one, on to, and bijective functions, inverse functions, composite functions, the concepts of image inverse image of a

set through a function, and also the relation between functions and ordered sets, (bounds, monotonicity),
- know the basic notions of propositional calculus and mathematical induction,
- know about the set theoretical construction of the natural numbers and integers, dividability, and the construction of rational numbers and through these of real numbers (Dedekind cuts),
- know the basic notions of complex numbers, their trigonometric form and also know how to apply these in solving equations in the set of complex numbers.

General Competencies

- Analysis and synthesis of data and information.
- Working independently.
- Decision making.
- Creation of new research ideas.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

- Elementary set theory. Union, intersection,. difference, symmetric difference of sets and related properties. Powerset and complement of a set, Cartesian product, set of sets. cover and partition of a set.
- Relations and their properties. Composition of relations. Equivalencies, classes of equivalence. Orders. Bounds and bounded sets. Supremum, infimum. Well ordered sets.
- Functions, basic concepts. One-to-one, onto, bijective functions. Inverse function. Composite function. Image and inverse image of a set through a function. Functions and ordered sets. Bounds. Monotonicity.
- Elementary notions of propositional calculus. Logical operations. Tautologies.
- Mathematical induction. Mathematical induction and well ordering. Full induction.
- The sets of natural numbers and integers. Dividability. The set of of rational numbers. Construction of real numbers through Dedekind cuts. The set of of irrational numbers. Completeness theorem in the set of real numbers.
- Complex numbers. Second degree equations in the set of complex numbers. Trigonometric form. Equation de Moivre. ν-th roots of a complex number. Fundamental Theorem of Algebra. Triangular inequality.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	LATEX and Scientific Workplace to prepare the course material. Powerpoint presentations.

	Use of the e-class platform to share notes-exercises-projects, and for communication through e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	65 hours
Individual Study	100 hours
Solving exercises and projects	35 hours
Course Total (25 hours per ECTS)	200 hours

STUDENT EVALUATION	Solving exercises and problems 25%. Written final examination 75%.

RECOMMENDED BIBLIOGRAPHY

1. Tsolomitis A., Sets and Numbers, Publications Leader Books, 2004. (Greek)
2. Tsamatos P., Fundamental Notions of Mathematical Analysis, Publications Tziola, 2009. (Greek)
3. Stewart I., Tall I., The Foundations of Mathematics, Oxford Univ. Press, 2015.

■ CC21 - Infinitesimal Calculus II

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC21	**SEMESTER**	B
COURSE TITLE	INFINITESIMAL CALCULUS II		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	5	8

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Infinitesimal Calculus I
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
After the successful completion of the course, the students: • will know the indefinite integral and its basic calculation techniques, • will know the definite integral (according to Riemann), • will apply the Fundamental Theorem of Integral Calculus for the calculation of the definite integral as well as the basic methods of changing variable and partial integration. • will apply the definite integral to calculate flat areas, and volumes of solids of revolution,

- will know the generalized integral and the basic convergence criteria of generalized integrals.

General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Making decisions.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Primitive function and indefinite integral. Definition of indefinite integral, basic properties, change of variable, integration by parts, integration of rational functions, integration of basic types of functions.
Definite integral (Riemann integral). Definition, properties, integrability criteria, mean value theorem, inequalities, Fundamental Theorem of Integral Calculus, change of variables. Applications of definite integrals. Calculation of the area of domains, the volume of solids of revolution and the length of arcs.
Generalized integrals. Types of generalized integrals and their calculation, basic properties, convergence criteria of generalized integrals of non-negative functions (comparison criterion, limit criterion, etc.), absolute convergence of generalized integrals, change of variable in the generalized integral.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Software GEOGEBRA. e-Lectures. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	65 hours
Individual Study	135 hours
Course Total (25 hours per ECTS)	200 hours

STUDENT EVALUATION	1. Written exam (progress) in the calculation of indefinite and definite integrals 30%. 2. Written final exam on all material 70%.

RECOMMENDED BIBLIOGRAPHY

1. THOMAS INFINITESIMAL CALCULUS, [George B. Thomas], Jr., Joel Hass, Christopher Heil, Maurice D. Weir. (Greek)
2. DIFFERENTIAL AND INTEGRAL CALCULUS, SPIVAK MICHAEL. (Greek)
3. General Mathematics - Infinitesimal Calculus, volume I, Athanasiadis Ch. E. Giannakoulias E. Giotopoulos S. Ch. (Greek)
4. Infinitesimal calculus, Briggs William, Cochran Lyle, Gillett Bernard. (Greek)
5. Kyventidis T., Integral Calculus of functions of one real variable, Ziti Press, 2005. (Greek)

■ CC22 - Linear Algebra II

GENERAL

SCHOOL	SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC22	**SEMESTER**	B
COURSE TITLE	LINEAR ALGEBRA II		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	7

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Linear Algebra I
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, students will be in position to: • compute eigenvalues and eigenvectors of a matrix, • examine whether a matrix is diagonalizable and to diagonalize matrices • diagonalize symmetric matrices using rectangular matrices, • compute ortho-canonical bases and orthogonal complements of spaces. • calculate the invariants of quadratic forms (connection with Analytic Geometry and surface recognition). • compute square root of a nonnegative real symmetric matrix and its norm.

General Competencies
• Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Eigenvalues. Eigenvectors. Eigenspaces. Diagonalization. The minimal and the characteristic polynomial. Cayley-Hamilton Theorem.
Euclidean spaces and an introduction to Ermitian spaces.
The Gram-Schmidt orthogonalization process, Orthogonal complement, Endomorphisms. Symmetric matrices. Spectral theorem.
Isometries. Quadratic forms. Main axes.
Measure of a matrix and square root of a nonnegative real symmetric matrix.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	e-Lectures. Use of the e-class platform to share notes-exercises-projects and for communication through e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	52 hours
Individual Study	123 hours
Course Total (25 hours per ECTS)	175 hours

STUDENT EVALUATION	Optional projects during the whole semester, with presentations. (bonus to the final grading) Final written exam on all material 100%.

RECOMMENDED BIBLIOGRAPHY

1. Linear Algebra, Theochari-Apostolidi Theodora, Charalambous Chara, Vavatsoulas Charilaos, Publications Tziola & Sons S.A. (2017). (Greek)
2. An Introduction to Linear Algebra, Varsos Dimitris, Deriziotis Dimitris, Emmanouil Giannis, Maliakas Michalis, Melas Antonis, Talelli Olympia, Publications Sophia (2012). (Greek)

3. Linear algebra with Applications, Holt Jeffrey, Publications Gutenberg (2023). (Greek)
4. Linear Algebra and Applications, Gilbert Strang, Publications University Publications of Crete (2021). (Greek)
5. Introduction to Linear Algebra, Papistas Athanasios, Publications Tziola & Sons S.A. (2019). (Greek)

■ CC23 - Analytic Geometry

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC23	**SEMESTER**	B
COURSE TITLE	ANALYTIC GEOMETRY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	5	7

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Linear Algebra I
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
After the successful completion of the course, the students: • will be able to use basic vector algebra (inner product, outer product, mixed product) in order to solve problems in the plane and space, • will be able to find equations of lines and planes and to be able to comfortably manage the Cartesian coordinate system in solving basic geometric problems, • will be able to use transformations of coordinate systems in the plane and in space, • will be familiar with basic curves and surfaces defined by quadratic polynomials.

General Competencies
• Search, analysis and synthesis of data and information, using the necessary technologies. • Adapting to new situations. • Working in an interdisciplinary environment. • Individual work. • Team work. • Generation of new research ideas. • Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Vector Calculus: Vectors and operations, linear independence, bases, coordinates, inner, outer, mixed and double outer product. Geometric Interpretation of the products. Coordinate systems in the plane and in space (general, orthonormal and polar). Coordinate system transformations.
Analytic geometry in space: Lines and planes in space (parametric equations, vector equation, Cartesian plane equation). Distance of a point from a line and plane. Relative positions of lines and planes in space.
Quadratic curves and surfaces in space.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	e-Lectures. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	**Activity** / **Semester Workload** Lectures — 65 hours Individual Study — 110 hours Course Total (25 hours per ECTS) — 175 hours
STUDENT	Written final examination 100%.

EVALUATION	

RECOMMENDED BIBLIOGRAPHY

1. S. Andreadakis, Analytic Geometry, Publications Symmetria. 1999 (Greek).
2. Th. Chrisakis, Linear Algebra and Analytic Geometry, Third Edition, Publications Tsotras, 2021 (Greek).
3. D. Georgiou, S. Iliadis, Analytic Geometry with elements of Linear Algebra, Publications Tziola, 2017 (Greek).
4. N. Kadianakis, S. Karanasios, Linear Algebra, Analytic Geometry and Applications, Publications Tsotras, 2017 (Greek).

■ CC24 - Introduction to Programming

GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	MY24	**SEMESTER**	B
COURSE TITLE	INTRODUCTION TO COMPUTER PROGRAMMING		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	5	8

COURSE TYPE	General Background
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course students will have been taught the basic programming concepts and skills required to solve basic problems.
General Competencies
• Search, analysis and synthesis of data and information, using the necessary technologies.

- Making decisions.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Algorithmic problem solving and programming with MATLAB.
Emphasis is given to basic programing techniques so that the students will be able to adapt easily to other programming languages. Also, the built in MATLAB functions and effective programming is presented. The course is oriented to mathematics students, problems addressed among others are series summation, vector and matrix operations, special matrices, descriptive statistics, basic plotting.
Variables, operators/expressions, assignment, input/output.
Loops and conditional statements
Matrices and Arrays. Searching /Sorting.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom and computer-lab.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Software MATLAB. e-Lectures. Use of e-class.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	65 hours
Programming tasks in MATLAB	45 hours
Individual Study	90 hours
Course Total (25 hours per ECTS)	200 hours

STUDENT EVALUATION	Programming tasks 30%. Written final examination in theory 70%.

RECOMMENDED BIBLIOGRAPHY

1. Stormy Attaway, MATLAB: a practical introduction to programming and problem solving, Publications Kleidarithmos. (Greek)
2. Charles F. Van Loan & K-Y Daisy Fan, The MATLAB in the Computing Science and Technology, DA VINCI Μ.Ε.Π.Ε. (Greek).

■ CC31 - Infinitesimal Calculus III

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC31	**SEMESTER**	C
COURSE TITLE	INFINITESIMAL CALCULUS III		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	5	8

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Infinitesimal Calculus I-II
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
After the successful completion of the course, the students will be able to: • find the domain of functions of several variables, • calculate partial derivatives of functions of several variables as well as find their total differential, • find the extrema of functions of several variables, • find the limits of functions of several variables, • check the continuity of functions of several variables,

- make approximations to functions of several variables with the help of the Taylor formula

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Making decisions.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

Calculus of many variables. Limits, continuity, partial derivatives and geometric interpretation. Formulas and theorems of partial derivatives. Extrema of functions of many variables. Limits of functions of several variables with constraints. The concept of total differential. Partial higher order derivatives. Distance of points, open and closed sets of R^n, boundary of a set.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Software Mathematica. e-Lectures. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	65 hours
Projects	47 hours
Individual Study	88 hours
Course Total (25 hours per ECTS)	200 hours

STUDENT EVALUATION	Projects 10%. Progress-Exams 20%. Written final examination 70%.

RECOMMENDED BIBLIOGRAPHY

1. J. Marsden, A. Tromba, Vector Calculus, Sixth Edition, University Publications of Crete, 2020 (Greek).
2. B. Papantoniou, Functions of Several Variables: Theory and Exercises, Publications Gartaganis (Greek).
3. R.L. Finney, M.D. Weir, F.R.Giordano, Infinite Calculus, University Publications of Crete, 2004 (Greek).
4. Chatziafratis T, Calculus of Functions of Several Variables, Symmetria Press, 2009 (Greek).
5. L. Tsitsas, Applied Vector Infinite Calculus, Publications Symmetria, 2003 (Greek).

■ CC32 - Introduction to Numerical Analysis

GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC32	**SEMESTER**	C
COURSE TITLE	INTRODUCTION TO NUMERICAL ANALYSIS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	7

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Introduction to Computer Programming
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the students will be able to: • know computer arithmetic, • approximate functions with polynomial interpolation, • apply numerical integration formulas for the approximation of integrals, • apply the basic methods for solving non-linear equations, study their convergence and distinguish them in terms of speed, • apply the basic direct and iterative methods for the solution of linear systems, • implement the above methods in MATLAB.

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Making decisions.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

Computer arithmetic and errors. Polynomial interpolation. Lagrange interpolating polynomial. Divided and Finite Differences. Newton interpolating polynomial Hermite interpolating polynomial.
Numerical differentiation. Numerical integration. Integration rules rectangle, trapezium, Simpson, 3/8. Adaptive quadrature. Gaussian integration.
Numerical solution of non-linear equations. Bisection method, regula falsi. fix point iteration methods, Newton-Raphson method, secant method, the Halley method.
Numerical solution of Linear Systems: Direct methods (Gauss Elimination, LU factorization), Iterative methods (Jacobi, Gauss-Seidel).

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	MATLAB. e-Lectures. Use of e-class.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	52 hours
Programming Tasks	48 hours
Individual Study	75 hours
Course Total (25 hours per ECTS)	175 hours

STUDENT EVALUATION	Programming tasks (MATLAB) 30%. Written final examination 70%.

RECOMMENDED BIBLIOGRAPHY

1. M.N. Vrachatis, Numerical Analysis, Kleidarithmos pub., 2012. (Greek)

2. G. Papageorgiou, Ch. Tsitouras, Numerical Analysis with applications to MATLAB and MATHEMATICA, Tsotras pub., 2015. (Greek)
3. M Gousidou-Koutita, Numerical Analysis, Kyriakidis pub., 2017 (Greek)
4. I. Th, Famelis, Computational Mathematics, Kritiki pub., 2021
5. N. Misyrlis, Numerical Analysis: an algothmic approach, Tsotras pub., 2022 (Greek)
6. G.D. Akrivis-V.A. Dougalis, Introduction to numerical analysis, Crete University Publications, 2017 (Greek).

■ CC33 - Ordinary Differential Equations

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC33	**SEMESTER**	C
COURSE TITLE	ORDINARY DIFFERENTIAL EQUATIONS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	7

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the students: • will be able to know the classification of Ordinary Differential Equations, • will be able to solve special forms of 1st and 2nd order differential equations, • will be able to apply an approximate method for solving 1st order differential equations that do not have an analytical solution, • will have understood the matrix method for solving systems of differential equations, • will have encounter problems of other scientific fields, the processing of which

depends on the construction and solution of appropriate differential equations.
General Competencies
• Familiarity with the use of the differential function. • Understanding the need to use numerical methods. • Promotion of inductive thinking.

CONTENT OF THE COURSE

The general linear equation of the first order. Linear equations with constant coefficients. Linear equations with variable coefficients. Linear equations with regular singular points. Existence and uniqueness of solutions to first order equations: equations with variables separated, exact equations, the method of successive approximations, the Lipschitz condition, convergence of the successive approximations. Non-local existence of solutions. Approximations to, and uniqueness of, solutions. Existence and uniqueness of solutions to systems and n-th order equations.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	E-Lectures. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	52 hours
Projects	43 hours
Indivisual Study	80 hours
Course Total (25 hours per ECTS)	175 hours

STUDENT EVALUATION	Projects 20%. Written final examination 80%.

RECOMMENDED BIBLIOGRAPHY

1. Ordinary Differential Equations, G. Dasios (1991)
2. Differential Equations, Kyventidis Thomas A. Publications ZITI (2012). (Greek)
3. Elementary Differential Equations and Boundary Value Problems, W.E. Boyce - R.C. Di Prima. Publications NATIONAL TECHNICAL UNIVERSITY OF ATHENS OE (2015). (Greek)
4. Introduction to Differential Equations, Logan David. LIBERAL BOOKS Publications (2014). (Greek)
5. Ordinary differential equations (2^{nd} edition), Nikolaos Alikakos, Grigoris Kalogeropoulos. Publications SYCHRONI EDTOTIKI (2019). (Greek)

■ CC34 - Probability I

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC34	**SEMESTER**	C
COURSE TITLE	PROBABILITY I		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	5	8

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the students: • will be able to use the basic rules of probability calculus, • will be familiarized with the notion of the univariate random variable, • will be able to gauge several parameters (mean value, covariance etc.) of probability distributions of discrete and continuous random variables, • will have consolidated the definitions of some basic univariate discrete and continuous probability distributions.
General Competencies

- Search for, analysis and synthesis of data and information, by use of the necessary technology.
- Decision making.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

Random phenomena. Sample space- event space- event operations. Classical probability definition, statistical regularity, geometric probability, axiomatic definition.
Conditional probability. Total probability theorem- Bayes formula, independence.
Basic combinatorial analysis, Permutations, Combinations. Stirling formula. Discrete and continuous random variables. Probability distribution function. Properties of probability distribution function. Functions of random variables.
Mean value, variance, standard deviation, moments, probability generating functions, moment generating functions.
Basic univariate discrete probability distributions (uniform, Bernoulli, binomial, geometric, hyper-geometric, Poisson, negative binomial).
Basic univariate continuous probability distributions (uniform, exponential, normal, Gamma).
Multi-dimensional random variables- multi-dimensional probability distributions.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	65 hours
Projects	45 hours
Individual Study	90 hours
Course Total (25 hours per ECTS)	200 hours

STUDENT EVALUATION	Projects 20%. Written final examination 80%.

RECOMMENDED BIBLIOGRAPHY

1. Kounias E. and Moysiadis P., Probability theory I , Ziti Publications 1995. (Greek)
2. Haralampidis C. A., Probability theory and applications, S. Athanasopoulos Publications, 2009. (Greek)
3. BASIC PRINCIPLES OF PROBABILITY THEORY, SHELDON ROSS, Publications KLEIDARITMOS 2011.
4. Introduction to Probability Theory and Applications, Koutras M., TSIOTRAS Publications ATH. 2018.

■ CC41 - Infinitesimal Calculus IV

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC41	**SEMESTER**	D
COURSE TITLE	INFINITESIMAL CALCULUS IV		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	5	8

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Infinitesimal Calculus I-III
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the students: • will know the definition of the integral of a scalar function of several variables, • will be able to decide whether a subset of Euclidean space is of measure or content zero, • will be familiar with the properties of the Riemann integral over orthogonal sections and be able to calculate such integrals using the Fubini theorem, • will be able to compute integrals over any Jordan measurable section, • will be familiar with the definitions and properties of epicurves and surface integrals,

- will be able to calculate curves and surface integrals, either directly, or by making use of the Green-Gauss-Stokes theorems.

General Competencies

- Individual work.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Double integrals: double integrals as volumes, Cavallieri's principle, reduction to iterated integrals. The double integral over a rectangle: definition and properties - criteria of integrability. Fubini's theorem. The double integral over more general regions. Mean-Value inequality. Triple integrals: definition and properties. The change of variables formula. Path and line integrals. Parametrized surfaces, area of a surface. Integrals of scalar/vector functions over surfaces. The integral theorems of vector analysis: Green, Gauss and Stokes theorems. Conservative fields.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	65 hours
Projects	45 hours
Individual Study	90 hours
Course Total (25 hours per ECTS)	200 hours

STUDENT EVALUATION	Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. Marsden, J., Tromba, A., Vector Calculus, Crete Univ. Press. (Greek)
2. Thomas, G., Finney, R., Vector Calculus, Crete Univ. Press. (Greek)

■ CC42 - Real Analysis

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC42	**SEMESTER**	D
COURSE TITLE	REAL ANALYSIS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	5	7

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Infinitesimal Calculus I-II
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With this course, the students will have the chance to study the theory of Real Analysis. Especially, with the successful attendance of the course, the students: • will be able to study sequences and series of functions, • will be able to study the convergence and uniform convergence of sequences and series of functions • will be able to integrate and differentiate series of functions • will be able to apply Weierstrass Approximation Theorem • will study main notions of Real Analysis.

General Competencies
• Search for, analysis and synthesis of data and information, with the use of the necessary technology. • Working independently for the enhancement of their self-esteem. • Creation of new research ideas. • Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

Basic notions of the Set Theory (countable and non-countable sets, examples, the countability of the set of rational numbers and the non-countability of the set of real numbers)
Sequences and series of real numbers, convergence criteria, representations of real numbers. Cantor set and Cantor function.
Classes of functions (monotone, bounded oscillation, absolute continuous, uniformly continuous convex etc). Sequences and series of functions. Uniform convergence, Weierstrass theorem. Uniform convergence and continuity. Integration and differentiation. Weierstrass Approximation Theorem, Equicontinuity, Ascoli-Arzela Theorem.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	**Activity** / **Semester Workload** Lectures — 65 hours Individual Study — 110 hours Course Total (25 hours per ECTS) — 175 hours
STUDENT EVALUATION	Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. D. Betsakos, Introduction to Real Analysis, Kyriakidi Press 2016 (Greek).
2. M. Anousis, A. Tsolomytis, V. Felouzis, Real Analysis, Publications Symmetria, 2014 (Greek).
3. P. Xenikakis, Real Analysis, Ziti Press, 1995 (Greek).
4. W. Rudin, Principles of Mathematical Analysis, Second version, Publications LIBERAL BOOKS, 2014 (Greek).
5. S. Negrepontis, Th.. Zachariadis, N. Kalamidas, V. Farmaki, General Topology and Function Analysis, Publications Symmetria, 1997 (Greek).

■ CC43 - Algebra I

GENERAL

SCHOOL	SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC43	**SEMESTER**	D
COURSE TITLE	ALGEBRA I		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	5	8

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Fundamental Notions of Mathematics
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With this course, the students: • will understand the notions of group, subgroup, cycle group, symmetric groups, permutation groups and quotient groups, • will be able to analyze the general properties/characteristics of groups, quotient groups and their elements, • will understand and will be able to apply the Groups' Isomorphism Theorems (Groups),

- will understand the notions of rings, ideals, quotient rings, fields and domains/integral domains.
- will be able to apply the Rings' Isomorphism Theorems.

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Working independently for the enhancement of their self-esteem.
- Creation of new research ideas.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

- Groups, subgroups, normal subgroups, symmetric groups, permutation groups,
- Generators – cyclic groups, order of a group, order of an element, Lagrange's Theorem, Quotient groups, Finite abelian groups.
- homomorphisms and isomorphisms of groups, kernel and image of an homomorphism, Isomorphism's Theorems of Groups.
- Rings, fields, (integral) domains, Ideals, Quotient rings,
- homomorphisms and isomorphisms of rings, Isomorphism's Theorems of Rings.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	65 hours
Individual Study	135 hours
Course Total (25 hours per ECTS)	200 hours

STUDENT EVALUATION	Optional projects during the whole semester, with presentations. (bonus to the final grading) Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. M.A. Amstrong, Groups and Symmetry, Publications Leader Books. (Greek)
2. A.Beligiannis, An introduction to Basic Algebra, Publications Kallipos, 2015. (Greek)
3. D. Dummit, R. Foote, Abstract Algebra, 3rd edition, Wiley publications, 2004. (English)
4. J. B. Fraleigh, Introduction to Algebra, University Publications Crete, 2012. (Greek)
5. M. Holz, Repetitorium Algebra: Short Theory and Problems, Publications Symmetria, 2015. (Greek)
6. N. Marmaridis, Group Theory, Publications Kallipos, 2015. (Greek)
7. D. Varsos, D. Deriziotis, I.Emmanouil, M. Maliakas and O. Talelli, An introduction to Algebra, 3rd edition, Publications Sophia, 2011. (Greek)

■ CC44 - Statistics I

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC44	**SEMESTER**	D
COURSE TITLE	STATISTICS I		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	5	7

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With this course, the students: • will consolidate the basic notions of Statistics, • will be able to process and analyze a data set, • will be evaluate the results of a survey.
General Competencies
• Application of knowledge in practice • Search for, analysis and synthesis of data and information, by use of the necessary

technology.
- Decision making.

CONTENT OF THE COURSE

Population, sample. Types of variables, frequency distribution, grouping data.
Graphs (bar charts, histograms, pie charts, stem and leaf plot, boxplot, time series chart, variance chart).
Measures of location and dispersion, calculations from simple or grouped frequency tables.
Use of R programming language for data representation.
Sampling distributions, distribution of random variable sums, the central limit theorem and its consequences in statistics.
Point and interval estimators, unbiasedness and efficiency. Unbiased minimum variance estimators, moment and maximum likelihood methods.
Confidence intervals and hypothesis testing for one and two samples (independent or paired) for the mean value and the variance. Confidence intervals and hypothesis tests for proportions. X^2 test (goodness of fit, independence and homogeneity).
Simple linear regression and correlation.
Non-parametric tests (runs test, randomization test, Kolmogorov-Smirnov test, Mann-Whitney test, Wilcoxon test, McNemar test, Kruskal-Wallis test, Friedman test, median test), Spearman correlation coefficient.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	65 hours
Projects	35 hours
Individual Study	75 hours
Course Total (25 hours per ECTS)	175 hours

STUDENT EVALUATION	Projects 20%. Written final examination 80%.

RECOMMENDED BIBLIOGRAPHY

1. Kolyva-Mahera F., Mpora-Senta E., Mpratsas H., Statistics, Ziti Publications, 2018 (Greek).
2. Papaioannou T., Loukas S. B., Introduction to Statistics, Stamouli Publications, 2002 (Greek).
3. Kounias E., Kolyva-Mahera F., Mpagiatis K., Mpora-Senta E.,Introduction to Statistics, Kyriakidis bros Publications, 2016 (Greek).
4. Damianou C., Koutras M., Introduction to Statistics, Vol. I, Tsiotras Athanasios Publications, 2021 (Greek).

■ CC51 - Algebra II

GENERAL

SCHOOL	SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC51	**SEMESTER**	E
COURSE TITLE	ALGEBRA II		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	5	8

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Fundamental Notions of Mathematics Algebra I
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the students: • will know the basic concepts of the Ring-Field Theory and Fields and they will be able to do calculations with ideals and apply isomorphism theorems, • will understand the notions of prime and maximal ideals, primary decomposition, unique factorization domains and principal ideal domains,

- will understand the notions of Noetherian and Artin rings.

General Competencies

- Individual work.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Rings and fields, integral domains, rings, homomorphisms-isomorphisms.
Fields of fractions, quotient rings, polynomial rings. Analysis of polynomials over a field, reduced polynomials.
Prime and maximal ideals.
Primary decomposition, Unique factorization domains. Principal ideal domains, Euclidean domains.
Jacobson radical. Noetherian rings. Artin Rings.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	65 hours
Projects	45 hours
Individual Study	90 hours
Course Total (25 hours per ECTS)	200 hours

STUDENT EVALUATION	Optional projects during the whole semester, with presentations. (bonus to the final grading) Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. M.F.Atiyah, I.G.Macdonald, Introduction to Commutative Algebra, Addison-Wesley Publishing Company, 1969. (English)
2. A.Beligiannis, An introduction to Basic Algebra, Publications Kallipos, 2015. (Greek)
3. D. Dummit, R. Foote, Abstract Algebra, 3rd edition, Wiley publications, 2004. (English)
4. J. B. Fraleigh, Introduction to Algebra, University Publications Crete, 2012. (Greek)
5. M. Holz, Repetitorium Algebra: Short Theory and Problems, Publications Symmetria, 2015. (Greek)
6. D.Varsos, D.Deriziotis, I.Emmanouil, M.Maliakas and O.Talelli, An introduction to Algebra, 3rd edition, Publications Sophia, 2011. (Greek)

■ CC52 - Operational Research

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC52	**SEMESTER**	E
COURSE TITLE	OPERATIONAL RESEARCH		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	7

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With this course, the students will be able to: • recognize and model real problems as linear programming models, • use the graphical method to solve linear programming problems, • solve linear programming problems with Simplex method, • use software to solve linear programming problems, • interpret the results ensuing from linear programming problem solutions, • solve special cases of problems: the transportation, transshipment and assignment problems.

General Competencies
• Search for, analysis and synthesis of data and information, with the use of the necessary technology. • Decision making. • Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

Linear programming problem modelling. Basic notions of Linear Programming. Graphical solution of linear programming problems in the two-dimensional space. Graphical sensitivity analysis of the linear model. Simplex algorithm. Big M method. Duality theory. Sensitivity analysis. The transportation problem. The assignment problem.

TEACHING AND LEARNING METHODS - EVALUATION

<table>
<tr><td>TEACHING METHOD</td><td>In the classroom.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Use of e-class.
Communication through face-to-face discussions and e-mails.</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td>
<table>
<tr><th>Activity</th><th>Semester Workload</th></tr>
<tr><td>Lectures</td><td>52 hours</td></tr>
<tr><td>Projects</td><td>20 hours</td></tr>
<tr><td>Individual Study</td><td>103 hours</td></tr>
<tr><td>Course Total
(25 hours per ECTS)</td><td>175 hours</td></tr>
</table>
</td></tr>
<tr><td>STUDENT EVALUATION</td><td>Projects 20%.
Written final examination 80%.</td></tr>
</table>

RECOMMENDED BIBLIOGRAPHY

1. Vassiliou P. and Tsantas N., Introduction to operational research, Ziti publications, 2000 (Greek).
2. Koletsos I. and Stogiannis D., Operational Research, Symeon publications, Athens, 2021 (Greek).
3. Kounias S. and Fakinos D., Linear Programming, Ziti publications, Thessaloniki,

1999 (Greek).
4. Siskos G., Linear Programming, New Technologies Publications, Athens, 1998 (Greek).
5. Taha H., Operational research An introduction, Pearson, (10th ed), 2017.
6. Bertsimas D. and Tsitsiklis J. N., Introduction to Linear Optimization, Athena Scientific 1997.

■ CC61 - Complex Analysis

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC61	**SEMESTER**	F
COURSE TITLE	COMPLEX ANALYSIS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	5	8

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Real Analysis
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With this course, the students: • will be familiar with the fundamental notions of topology for the complex plane, • will be able to understand the definition of the branches of the logarithmic function at the complex plane, • will be able to calculate by definition the complex derivative of basic functions, as well as use the Cauchy-Riemann conditions, • will be able to calculate simple complex integrals with both the definition and the Cauchy integral formula,

- will be able to use the theorems of Liouville and analytic continuation expansion, as well as the maximum/minimum principles, to solve exercises,
- will be able to classify specific points of complex functions and calculate Taylor or Laurent expansions at these points,
- will be able to use the Residue theorem to calculate complex integrals, but also real integrals of a specific form.

General Competencies

- Individual work.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Complex plane and operations with complex numbers. Topology of the complex plane (open, closed, connected and simply connected sets, sequences, series). Elementary complex functions. Continuous and holomorphic functions. Cauchy-Riemann equations. Complex integration, theorems and Cauchy's integral formula. Taylor expansion, calculus of integrals. Liouville theorem, maximum/minimum principles. Cauchy's formula on a ring. Isolated singularities. Laurent expansion. Residue Theorem, calculation of curves and real integrals.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	
STUDENT EVALUATION	Written final examination 100%.

Activity	**Semester Workload**
Lectures	65 hours
Projects	45 hours
Individual Study	90 hours
Course Total (25 hours per ECTS)	200 hours

RECOMMENDED BIBLIOGRAPHY

1. Betsakos D, Introduction to Complex Analysis, Kyriakidi Press (Greek).
2. Negrepontis S, Theory of Functions of a Complex Variable, Symmetria Press (Greek).
3. Merkourakis S and Chatziafratis T, Introduction to Complex Analysis, Symmetria Press (Greek).
4. Marsden J, Hoffman M, Basic Complex Analysis, Symmetria Press (Greek).

■ CC62 - Differential Geometry I

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC62	**SEMESTER**	F
COURSE TITLE	DIFFERENTIAL GEOMETRY I		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	7

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Linear Algebra I-II Infinitesimal Calculus III-IV
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the students will be able to: • find the Frenet trihedron of a curve in space with parameterization along an arc and calculate its curvature and torsion, • check if a surface is regular and find the tangent plane of a regular surface, • calculate the first and second fundamental form and the various curvatures of a surface,

- formulate and understand the meaning of Gauss' Theorema Egregium.

General Competencies

- Individual work.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Curves in the plane and in space: tangent of a normal curve, arc length-physical parameter, accompanying Frenet trihedron, curvature and torsion, fundamental theorem of curves, the isoperimetric inequality.
Normal Surfaces: Complex Function Theorem and normal surfaces, tangent plane, first and second fundamental form, Gauss mapping, shape operator, vertical and mean curvature, principal curvatures, Gauss curvature, the "Marvelous" Theorem (Theorema Egregium).

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	52 hours
Projects	50 hours
Individual Study	73 hours
Course Total (25 hours per ECTS)	175 hours

STUDENT EVALUATION	Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. Barett O'Neil, Elementary Differential Geometry, Third Edition, Publications ITE, Crete Un. Press, 2005 (Greek).
2. Pressley A, Elementary Differential Geometry, Third Edition, Publications ITE, Crete Un. Press , 2011 (Greek).

3. B. Papantoniou, Differential Geometry, Patras Un. Press (Greek).
4. D. Koutroufiotis, Elementary Differential Geometry, Publications Leader Books, 2006 (Greek).
5. Arvanitogeorgos A, Elementary Differential Geometry, e-book, Kallipos Repository , 2015 (Greek).

■ CE51 - Numerical Linear Algebra

GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE51	**SEMESTER**	E
COURSE TITLE	NUMERICAL LINEAR ALGEBRA		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Introduction to Numerical Analysis
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the students: • will be able to understand the basic matrix theory, • will be able to apply numerical methods for solving linear systems, • will know the basic matrix factorizations

- will be able to choose the appropriate method taking into account the stability, the convergence rate as well as the state of the system,
- will be able to apply MATLAB functions for linear algebra,
- will be able to implement the above methods with their own functions in MATLAB.

General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Making decisions.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Vector and matrix norms. Numerical Solution of Linear Systems. Sensitivity of linear systems.
Direct Methods: Gaussian elimination, Gauss tranformations. LU factorizations, pivoting.
Factorization of special matrices LDM, LDLT and Cholesky.
Iterative methods: Jacobi, Gauss-Seidel, SOR.
The linear least squares problem.
Householder transformations, QR factorization, SVD.
Implementation with MATLAB.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Software MATLAB. e-Lectures. Use of e-class.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	52 hours
Programming Tasks in MATLAB	26 hours
Individual Study	47 hours
Course Total (25 hours per ECTS)	125 hours

STUDENT EVALUATION	Programming Tasks in MATLAB 30%. Written final examination 70%.

RECOMMENDED BIBLIOGRAPHY

1. G. Avdelas, Th. Simos, Numerical Linear Algebra, Tsotras pub.,2016 (Greek)
2. G.H. Golub, C.F. Van Loan, Matrix Computations, Pedio pub., 2015 (Greek translation).
3. A. Sifaleras, G. Stefanidis, Linear Algebra with MATLAB and SageMath, Tziola pub., 2021 (Geek)
4. G Papageorgiou, X. Tsitouras, Numerical Analysis with applications in MATLAB and MATHEMATICA, Tsotras pub. (Greek)
5. I. Th, Famelis, Computational Mathematics, Kritiki pub., 2021
6. N. Misyrlis, Numerical Analysis: an algothmic approach, Tsotras pub., 2022 (Greek)

■ CE52 - Number Theory

GENERAL

SCHOOL	SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE52	**SEMESTER**	E
COURSE TITLE	NUMBER THEORY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With this course, the students will learn the classical Number Theory, the Diofantic equations, the numerical functions, numbers modulo n, Congruencies and linear systems of congruencies.

In particular, they will learn to use issues of divisibility and factorization in the set of integers numbers and issues of finding integer solutions of types of Diofantic equations.

They will know the basic Arithmetical functions and they will learn in deep the theory of prime numbers. The notion of congruencies will be analyzed and they will know to solve linear systems of congruencies.

With the successful attendance of the course, the students will have the basic mathematical background in Number Theory. The last will give them the tools to study topics of Algebra, Geometry and Analysis.

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Working independently for the enhancement of their self-esteem.
- Creation of new research ideas.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

- The notion of divisibility in the set of integers numbers, highest common factor and least common multiple, Euclidean division. Perfect numbers, Prime numbers, Fundamental Theorem of Arithmetic.
- Diofantic equations, Arithmetical functions, numbers modulo, Theorems of Fermat, Euler and Wilson.
- Polynomial and linear congruences, linear systems of congruences, Chinese remainder theorem.
- Primitive mod p roots. Theory of indices and quadratic residues, *Quadratic* Reciprocity *Law*, symbols of Legendre and Jacobi.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours

	Individual Study: 73 hours Course Total (25 hours per ECTS): 125 hours
STUDENT EVALUATION	Optional projects during the whole semester, with presentations. (bonus to the final grading) Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. Deriziotis D., An introduction to Number Theory, Publications Sophia, second version, 2012 (Grrek).
2. Tsagaris P. G., Number Theory, Publications Symmetria, third version, 2010 (Greek).
3. Poulakis D. M., Number Theory, Publications Ziti, 1997 (Greek).
4. Tzanakis N.K., Fundamental Number Theory, Department of Mathematics, University of Crete, 2019 (Greek).

■ CE53 - Probability II

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE53	**SEMESTER**	E
COURSE TITLE	PROBABILITY II		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Probabilities I
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With this course, the students: • will be familiarized with the notion of multi-dimensional random variable, • will be able to study the marginal random variables of a multi-dimensional random variable, • will be able to gauge moments of multi-dimensional random variables, • will be able to study conditional random variables of a multi-dimensional random variable, • will be able to handle moment generating functions of multi-dimensional random

variables,
- will be able to apply the central limit theorem.

General Competencies

- Search for, analysis and synthesis of data and information, by use of the necessary technology.
- Decision making.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

Axiomatic definition of probabilities. Definition of a random variable and a random vector. Probability distribution and density functions. Multi-dimensional random variables (discrete and continuous ones). Multi-dimensional distributions. Radon-Nikodym theorem. Useful multi-dimensional distributions. Properties of multi-dimensional random variables (multi-dimensional mean values, variance-covariance matrices etc.). Conditional probability distributions. Ordered random variables. Characteristic functions of multi-dimensional random variables. Moment and probability generating functions of multi-dimensional random variables. Applications of multi-dimensional random variables, Convergence of sequences of random variables- convergence classification. Limit Theorems (laws of large numbers, Central limit theorems etc.)

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	52 hours
Projects	20 hours
Individual Study	53 hours
Course Total (25 hours per ECTS)	125 hours

STUDENT	Projects 20%.

EVALUATION	Written final examination 80%.

RECOMMENDED BIBLIOGRAPHY

1. Kounias E. and Kalpazidou S., Probabilities II Theory and Exercises, Ziti Publications 1991 (Greek).
2. Charalampidis C. A., Probability theory and applications, S. Athanasopoulos Publications, 2009 (Greek).
3. Sheldon R., A first course in probability, Pearson Prentice Hall.
4. Feller W. An Introduction to Probability Theory and its applications, Vol. 1, John Wiley & Sons Inc.

■ CE54 - Classical Mechanics

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE54	**SEMESTER**	E
COURSE TITLE	CLASICAL MECHANICS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	General Knowledge
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With the completion of the learning process, the students will be able to: • know basic categories of mechanical systems and their fundamental principles (laws of conservation and principles of minimum action) • analyze with systematic and documented mathematical methodologies, fundamental classes of mechanical systems, • apply basic methods of the calculus to basic engineering problems, having acquired a valuable background in the relevant mathematical theories, • apply modern methods based on the theory of dynamical systems, for the analysis

of flows defined by systems of classical mechanics, having been introduced to basic concepts of dynamics.

General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Making decisions.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Newton's equation for point mass system, conservative forces, conservation laws (energy, angular momentum, linear momentum) and Galilean transformations. Elements of theory of variations. Lagrange Mechanics: Generalized positions and velocities, Lagrangian function and integral of action, D'Alembert's principle, Hamilton's principle, Euler-Lagrange equations.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	e-Lectures. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	52 hours
Projects	42 hours
Individual Study	31 hours
Course Total (25 hours per ECTS)	125 hours

STUDENT EVALUATION	Projects 10%. Progress-Exam 20%. Written final examination 70%.

RECOMMENDED BIBLIOGRAPHY

1. Modern Theoretical Mechanics, K. Tsiganos, Stamouli Publications. (Greek)

2. Classical Mechanics, S. Pnevmatikos, Scientific and Technological Publications A.G. Pnevmatikos. (Greek)
3. Theoretical Mechanics, Petros Ioannou, Theoharis Apostolatos, University of Athens Property Development and Management Company. (Greek)

■ CE55 - Computer Programming with C

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE55	**SEMESTER**	E
COURSE TITLE	COMPUTER PROGRAMMING WITH C		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Skills Development
PREREQUISITE COURSES	Introduction to Programming
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
The course aims to familiarize the students with the basic concepts of computer programming with the C language. Upon successful completion of the course, the student will be able to: • understand the basic structure of a program with C, • understand the concept of variables and different categories of data types, • become familiar with the properties and value ranges of different types of variables, • create new, complex data types,

- become familiar with the selection structures and their variations,
- become familiar with repetition structures and their variations,
- understand the concept of functions, their gradient and their implementation (as sub-programs),
- become familiar with how to pass parameters to functions, and output values from functions via return value and parameters,
- know how to declare and use pointers to each type of data (ready or complex),
- understand the concept of stack and heap,
- create statically declared and dynamic arrays, by committing memory on the stack and on the heap, respectively,
- pass arrays to functions, either for input or output,
- use appropriate repetition structures and functions to solve basic mathematical problems,
- apply C programming in practice to solve complex problems,
- know introductory concepts of programming in C++,
- collaborate, where appropriate, with fellow students to create and present simple applications that demonstrate the concepts of each module.

General Competencies

- Individual work.
- Team work.
- Project Planning and Management.
- Exercise criticism and self-criticism.

CONTENT OF THE COURSE

The course introduces the fundamental concepts of computer programming with the C language. An industrial-scale compiler and development environment (IDE) are used to familiarize the students with professional tools. Basic concepts of basic variables, their types, capabilities and usage are covered. Furthermore, the creation of complex programmer-defined types is described in detail. Also, all selection and repetition structures are studied, with characteristic examples of conversion between them (depending on the category and the requirements). Memory management, both static and dynamic, is discussed in detail, along with pointers, dynamically allocating and freeing memory on/from the heap, and using it as one-dimensional or multi-dimensional, dynamically mutable arrays. Functions, input and output of values to/from them, and demonstration of them in common math problems are presented. These are applied to mathematical algorithms of various objects, such as e.g. numerical analysis, geometry, etc.

More specifically, the content of the course covers the following:

Section 1: The basic structure of a program in C. Introduction to the development environment of Visual Studio 2019. Introduction to the concept of variables of various types and classes. Limits and capabilities of ready-made data types. Operations with variables.

Section 2: Creating new, complex data types. Accessing the variable fields of complex

types. Location of fields and/or sub-fields in memory.
Section 3: Selection structures (if and switch), as well as a comparison between them. Extensive examples of their use.
Section 4: Repetition structures (for, while, do-while), as well as a comparison between them. A summary description of them, with the aim of making the best choice for the student, depending on each case. Convert between them, as well as referencing the basic iteration loop.
Section 5: Introduction to functions, using their parameters for input and output, and the optional return value.
Section 6: Static (stack) and dynamic memory (heap). Pointer declaration, dynamic memory allocation for ready or complex types.
Section 7: Statically and dynamically declared 1, 2, 3, 4 and 5 dimensional arrays. Passing arrays to functions for input and output.
Section 8: Use appropriate recurrence structures and functions to solve various basic mathematical problems. Practical application of C programming to solve complex problems.
Section 9: Demonstration of the use of the material of the previous sections in iterative methods (Conjugate Gradient and Jacobi-Accelerated Preconditioned Conjugate Gradient) of solving large-scale numerical systems. Solving integrals with the trapezium method, matrix operations, problems limited by memory or processor. Accurate timing of the above. Examples of parallel code in math problems.
Section 10: Introduction to basic concepts of object oriented programming with C++.
Section 11: Standard functions.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Software MATLAB. e-Lectures. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours
Projects	18 hours
Individual Study	55 hours
Course Total (25 hours per ECTS)	125 hours

STUDENT EVALUATION	Written final exam (100%) in the Greek language, which includes: - Short answer questions - Problem solving - Optional exercises and tasks, individual or group - Comparative assessment of theory. During the semester, the students are given individual assignments or group exercises and assignments, as well as a larger optional group assignment covering several subject areas simultaneously.

RECOMMENDED BIBLIOGRAPHY

1. Cheng H. (2012) C for scientists and engineers. 1st Edition. Tziola Publications. (Greek)
2. Tan H and D' Orazio T. (2000) C for engineers. 1st Edition. Tziola Publications. (Greek)
3. Tselikis GS and Tselikas ND. (2016) C: From theory to practice. 3rd Edition. Publisher: Tselikis Georgios. (Greek)
4. Hanly Jeri R. and Koffman Elliot B. (2021) Principles and Techniques of Programming with the C Language. 1st Edition. Kritiki Publications S.A. (Greek)
5. Hatzigiannakis NM. (2017) The C language in depth. 5th Edition. Kleidaritmos S.A. Publications. (Greek)
6. Paul Deitel, Harvey Deitel. (2014) A Programmer's Guide to C. 1st Edition. Ch Giourda & Co Publications S.A. (Greek)
7. Abbey Deitel, Harvey Deitel. (2014) C Programming. 7th Edition. Ch Giourda & Co Publications SA. (Greek)
8. Karolidis Dimitrios A. (2021) Learn C easily. 2nd Edition. Pinelopi Xarhakou Publications. (Greek)

■ CE56 - Fourier Analysis

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE56	**SEMESTER**	E
COURSE TITLE	FOURIER ANALYSIS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the students will be able to: • know the measure and the Lebesgue integral, • have understood trigonometric polynomials, • recognize Fourier series and apply the convergence criteria of their partial sums, • solve Sturm-Liouville problems using integral calculus, • know the integral transforms (Laplace and Fourier) and use them in solving differential and integral equations.
General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Adapting to new situations, making decisions.
- Work in a team.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Calculus of variations: Euler's differential equation. Problems of variations in conditions. Hamilton's principle. Lagrange's equations. Sturm-Liouville problems. Rayleigh-Ritz method. Laplace transformation: Properties- Inverse transformation- Applications to ordinary differential equations- Applications to partial differential equations. Fourier analysis: Orthogonal functions-Fourier series-Fourier integrals. Fourier transformation-Applications to partial differential equations. Bessel's functions-Legendre's functions. Integral Equations: Connection to Differential Equations.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	**Activity** / **Semester Workload** Lectures: 52 hours Individual Study: 73 hours Course Total (25 hours per ECTS): 125 hours
STUDENT EVALUATION	Progress-exam (calculation of indefinite and definite integrals) 30% Written final examination 70%.

RECOMMENDED BIBLIOGRAPHY

1. FOURIER ANALYSIS, Kolountzakis M., Papachristodoulos X., Kallipos. (Greek)
2. APPLIED MATHEMATICS, Mylonas N., Hatzarakis G. Tziola Publications. (Greek)

■ CE57 - Topology

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE57	**SEMESTER**	E
COURSE TITLE	TOPOLOGY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Real Analysis
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With the successful attendance of the course, the students: • will understand basic notions of General Topology such as the notions of topological space, subspace, base and subbase, • will define topologies on a set, • will recognize various sets of a topological space like the open, closed, dense and nowhere dense sets, • will categorize the topological spaces under the view of separation axioms,

- will be able to use mappings between topological spaces like the continuous mappings, the open and closed mappings and the homeomorphisms,
- will understand the meaning of the Moore-Smith convergence and the necessity to generalize the notion of sequence in topological spaces,
- will understand the product of topological spaces,
- will understand the notions of compactness, local compactness and compactification,
- will understand the notions of connectedness, local connectedness and path connectedness,
- will understand the importance of Topology through its applications in various branches of Mathematics.

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Working independently for the enhancement of their self-esteem.
- Creation of new research ideas.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

Metric spaces: Notion of metric space, examples of metric spaces, basic notions of metric spaces such as open and closed sets, closure, interior and boundary of a set.
Topological spaces: Notion of topology and examples of topological spaces,basic notions of topological spaces like open and closed sets, closure, interior, boundary, subspace, base and subbase of topology.
Separation axioms: T_0-space, T_1-space, T_2-space (or Hausdorff space), regular spaces, completely regular spaces, normal spaces.
Mappings and Moore-Smoth sequences: Continuous mappings, homeomorphisms, open and closed mappings, examples of mappings between topological spaces, Moore-Smith sequences.
Product of topological spaces: Product of finite and infinite family of topological spaces, properties of the product of topological spaces.
Compact topological spaces: The meaning of the compact topological space, examples of compact topological spaces, continuous mappings and compact topological spaces, local compact topological spaces, compactification.
Connected topological spaces: The meaning of the connected topological space, examples of connected topological spaces, continuous mappings and connected topological spaces, connected components, local connected topological spaces, path connected topological spaces.
Applications of Topology in branches of Mathematics.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class,. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	**Activity** / **Semester Workload** Lectures — 52 hours Individual Study — 73 hours Course Total (25 hours per ECTS) — 125 hours
STUDENT EVALUATION	Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. D. Georgiou, S. Iliadis, General Topology, Publications Tziola, 2017 (Greek).
2. S. Negrepontis, Th.. Zachariadis, N. Kalamidas, V. Farmaki, General Topology and Function Analysis, Publications Symmetria, 1997 (Greek).

■ CE58 - Discrete Mathematics

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE58	**SEMESTER**	E
COURSE TITLE	DISCRETE MATHEMATICS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes

Upon successful completion of the course, the students will be able to:

- compose mathematical arguments using mathematical logic,
- use evidential procedures, such as that of mathematical induction,
- apply combinatorial analysis to solve enumeration problems,
- know the concept of graphs and use them in simplifying and solving complex problems.

General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Adapting to new situations, making decisions.
- Work in a team.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Sets and operations.
Propositional Logic and equivalences.
Proof methods (mathematical induction) and proof strategy.
Complexity of algorithms.
Relations and properties. Equivalence relation and classes, partial ordering relation.
Presentation of relations.
Integers and division. Elements of number theory.
Enumeration. Combinations, permutations.
Graphs and terminology. Graph representation. Subgraphs and isomorphisms. Coherence. Trees. Binary graphs. Matching in bipartite graphs. Maximum matches. Euler and Hamiltonian paths and circuits.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	**Activity** / **Semester Workload** Lectures — 52 hours Individual Study — 73 hours Course Total (25 hours per ECTS) — 125 hours
STUDENT EVALUATION	Progress-exam (calculation of indefinite and definite integrals) 30% Written final examination 70%.

RECOMMENDED BIBLIOGRAPHY

1. DISCRETE MATHEMATICS & Their Applications., Kenneth H. Rosen, Tziola Publications. (Greek)
2. DISCRETE MATHEMATICS & Their Applications, Susana S. Epp, Publications Kleidarithmos. (Greek)
3. DISCRETE MATHEMATICS, Kolountzakis M., Papachristodoulos C., Kallipos. (Greek)

■ CE58 - Discrete Mathematics

GENERAL

SCHOOL	SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE58	**SEMESTER**	E
COURSE TITLE	DISCRETE MATHEMATICS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes

Upon successful completion of the course, the students will be able to:

- compose mathematical arguments using mathematical logic,
- use evidential procedures, such as that of mathematical induction,
- apply combinatorial analysis to solve enumeration problems,
- know the concept of graphs and use them in simplifying and solving complex problems.
- know all the basic families of graphs and their properties.

General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Adapting to new situations, making decisions.
- Work in a team.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Sets and operations. Propositional Logic and equivalences. Proof methods (mathematical

induction) and proof strategy.

Relations and properties. Equivalence relation and classes, partial ordering relation.

Enumeration. Binomial Coefficients, Generator Functions, Combinations, permutations. Inclusion-Exclusion Principle.

Graphs and terminology. Graph representation. Subgraphs and isomorphisms. Connectivity. Trees. Bipartite graphs. Matching in bipartite graphs. Planar graphs. Maximum matches. Euler and Hamiltonian paths and circuits and graphs. Theorems of Kirchhoff, Dirac, Menger.

TEACHING AND LEARNING METHODS - EVALUATION

<table>
<tr><td>TEACHING METHOD</td><td>In the classroom.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Use of e-class.
Communication through face-to-face discussions and e-mails.</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td><table><tr><th>Activity</th><th>Semester Workload</th></tr><tr><td>Lectures</td><td>52 hours</td></tr><tr><td>Individual Study</td><td>73 hours</td></tr><tr><td>Course Total
(25 hours per ECTS)</td><td>125 hours</td></tr></table></td></tr>
<tr><td>STUDENT EVALUATION</td><td>Optional projects during the whole semester, with presentations. (bonus to the final grading)
Written final examination 100%.</td></tr>
</table>

RECOMMENDED BIBLIOGRAPHY

1. Discrete Mathematics, C.Athanasiadis, Publications Efaltirio, 2023. (Greek)
2. Discrete Mathematics, Kolountzakis M., Papachristodoulos C., Kallipos. (Greek)
3. Discrete Mathematics and their applications., Kenneth H. Rosen, 8th edition, Tziola Publications, 2018. (Greek)
4. Discrete Mathematics and their Applications, Susana S. Epp, Publications Kleidarithmos, 2010. (Greek)

■ CE59 - Partial Differential Equations

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE59	**SEMESTER**	E
COURSE TITLE	PARTIAL DIFFERENTIAL EQUATIONS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Infinitesimal Calculus II-III-IV Ordinary Differential Equations
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With the successful completion of the course, the student will be able to: • understand the concept of a partial differential equation, its difference compared to an ordinary differential equation both in the form of its solutions and its solution techniques, • understand concepts such as initial conditions-boundary conditions, • recognize the type of a partial differential equation and be able, in any case, to apply specific techniques for solving differential equations with partial first and

second order derivatives in initial and boundary value problems,
- be able to examine the form of the solutions by drawing conclusions about the model under consideration and trying to apply knowledge from theoretical mathematics.

General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Adapting to new situations.
- Working in an interdisciplinary environment.
- Individual work.
- Team work.
- Creation of new research ideas.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

POE of first order, linear and almost-linear equations, Cauchy's problem, Monge cones-characteristic strips, Solving linear POE of α order with the method of transformations, total differential equations, Charpit method. Classification of second-order differential equations, normal forms, D' Alembert-type wave equation, propagation of discontinuities, wave reflections, separation of variables method, wave equation, diffusion equation, Laplace equation, initial and boundary value problems of Dirichlet, Neumann, Robin types, Fourier series, orthogonal functions, Sturm-Liouville eigenvalue problems, generalized functions or distributions, finding fundamental solutions with Fourier and Laplace transforms.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	e-Lecture. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	40 hours
Teaching Exercises	20 hours
Solving Selected Exercises	25 hours

	Individual Study: 40 hours Course Total (25 hours per ECTS): 125 hours
STUDENT EVALUATION	Written final examination 100% whcich includes: - Theory - Solving Exercises - Applications to Mathematical Physics.

RECOMMENDED BIBLIOGRAPHY

1. Partial Differential Equations, Trachanas S. (Greek)
2. Partial Differential Equations, Akrivis G., Alikakos N. (Greek)
3. Partial Differential Equations, Skoutaris N. (Greek)
4. Partial Differential Equations, Vol. A, Tsoumpelis D. (Greek)
5. Partial Differential Equations, Volume 1, Kyventidis Th. (Greek)
6. Walter A. Strauss, Partial Differential Equations: An Introduction, 2nd edition, Wiley, 2008.
7. Fritz John, Partial Differential Equations, 4th edition, Springer, 1982.
8. Stanley J. Farlow, Partial Differential Equations for Scientists and Engineers, 2nd edition, Dover Pub. Inc., 1993.
9. J. David Logan, Applied Partial Differential Equations, 2nd edition, Springer, 2000.
10. Paul W. Berg and James. L. McGregor, Elementary Partial Differential Equations, Holden-Day, 1980.
11. Lawrence C. Evans, Partial Differential Equations, 2nd edition, AMS, 2010.
12. Gerald B. Folland, Introduction to Partial Differential Equations, 2nd edition, Princeton University Press, 1995.

■ CE61 - Numerical Solving of Differential Equations I

GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE61	**SEMESTER**	F
COURSE TITLE	NUMERICAL SOLVING OF DIFFERENTIAL EQUATIONS I		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Introduction to Numerical Analysis
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With the successful completion of the course, the students will be able to: • know and apply single step methods, • know and apply multistep methods,, • implement the above methods with their own functions in MATLAB.
General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Making decisions.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Introduction to the numerical solution of differential equations, The need and the use of numerical methods.
History of numerical methods for ordinary differential equations, early methods Euler, Heun, Kutta, Adams Bashforth, Numerov.
Systems of first order ODEs.
Taylor method. Runge-Kutta methods.
Multistep methods Adams-Multon, Adams Bashforth.
Special second order ODEs Runge-Kutta-Nystrom methods, Numerov method.
Error analysis, stability analysis, stiff problems, boundary value problems.
Introduction numerical methods for partial differential equations.
Implementation with MATLAB.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	MATLAB. e-Lectures. Use of e-class.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	52 hours
Programming Tasks in MATLAB	26 hours
Individual Study	47 hours
Course Total (25 hours per ECTS)	125 hours

STUDENT EVALUATION	Programming tasks in MATLAB 30%. Written final examination 70%.

RECOMMENDED BIBLIOGRAPHY

1. Z. Kalogiratou, Th. Monovasilis, Numerical Integration of Differential Equations, Kallipos Open Academic Editions, 2024. https://dx.doi.org/10.57713/kallipos-441. (Greek)
2. M. N. Vrachatis, Numerical Analysis: Ordinary Differential Equations, Kleidarithmos Pub. 2012 (Greek)
3. G.D. Akrivis, A.B.Dougalis, Numerical methods for Ordinary Differential Equations, Crete University Publications, 2015.

■ CE62 - Stochastic Processes

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE62	**SEMESTER**	F
COURSE TITLE	STOCHASTIC PROCESSES		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With this course, the students: • will be familiarized with the concept of stochastic processes, • will be able to recognize basic stochastic models, • will be able to model real problems by use of stochastic processes, • will be able to study the asymptotic behaviour of a Markov process.
General Competencies
• Search for, analysis and synthesis of data and information, with the use of the

necessary technology.
- Decision making.
- Production of free, creative and inductive thinking.

CONTENT OF THE COURSE

Introduction to Stochastic Processes, discrete-time Markov Chains, Chapman-Kolmogorov equations. Classification of states. Description of the evolution of a Markov Chain. Hitting time. Distributions of sojourn time. Asymptotic results, stationary distribution. Continuous-time Markov Chains. Poisson process and generalizations. Introduction to Queuing Theory.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours
Projects	26 hours
Individual Study	47 hours
Course Total (25 hours per ECTS)	125 hours

STUDENT EVALUATION	Projects 20%. Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. Vassiliou P.-C., Stochastic Methods in Operations research, Publications Ziti, 2000 (Greek).
2. Fakinos D., Stochastic models in Operations research: Theory and applications, Symmetria, 2007 (Greek).
3. Daras T. and Sypsas P., Stochastic processes, Theory and applications, Publications Ziti, 2003 (Greek).
4. Loulakis M., Stochastic processes, Hellenic Academic EBooks-“Kallipos” repository, 2016 (Greek).

■ CE63 - Data Bases

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE63	**SEMESTER**	F
COURSE TITLE	DATA BASES		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Skills Development
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
The purpose of the course is to introduce students to relational databases, emphasizing how to design and implement databases using the SQL relational language. Upon successful completion of the course, the students should: • get to know the basic concepts and terms of DBMS, the relational data model and how to design them by applying the principles of the entity-relationship model, • understand the capabilities and advantages of relational databases, • design efficient and functional N.D. systems, • implement simple database applications with SQL.

General Competencies
• Search for, analysis and synthesis of data and information, with the use of the necessary technology. • Decision making. • Production of free, creative and inductive thinking.

CONTENT OF THE COURSE

Introduction to the basic concepts of data storage and management using DBMS (Data Base Management Systems).
Comparison of Relational Data Storage Model with traditional file organization.
Refer to database models.
Introduction to relational database systems.
Design relational databases applying the principles of the entity-relationship model.
The SQL relational language.
Relational algebra.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Power point presentations of theory. Online self-assessment exercises. Learning process support through the moodle online platform.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	26 hours
Exercises	13 hours
Laboratory Exercises	26 hours
Semester Project	7 hours
Individual Study	53 hours
Course Total (25 hours per ECTS)	125 hours

STUDENT EVALUATION	Written final exam (50%) and examination of the laboratory exercises (50%). The written final exam includes:

	-multiple choice questions, -solving problems of applying the acquired knowledge, -comparative evaluation of theory elements. The examination of the laboratory exercises includes: -the evaluation of the student's written laboratory reports, -the assessment of laboratory skills acquired through an examination in which laboratory equipment is used.

RECOMMENDED BIBLIOGRAPHY

1. Database Systems, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, X. GKIOURDA & Co EE. (Greek)
2. Fundamentals of Database Systems, Elmasri Ramez, Navathe Shamkant B.
3. INTRODUCTION TO DATABASE SYSTEMS, VOLUME A DATE C. J., Kleidaritmos Publications.
4. Database System Concepts, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill Science/Engineering/Math Publishing.

■ CE64 - Data Structures

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE64	**SEMESTER**	F
COURSE TITLE	DATA STRUCTURES		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Skills Development
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
When the student successfully completes the course he will be able to: • describe the Data Structures (D.D.) that he/she uses, • assess the possibilities (advantages-limitations) of a specific D.D., • examine the respective problem in relation to the available D.D., • plan the appropriate D.D. in each case, • create-implement the selected D.D. in C programming language, • compare and evaluate the performance of D.D.
General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Adapting to new situations.
- Making decisions.
- Independent work.
- Team work.
- Criticism and self-criticism.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Introduction to Data Structures Necessity-Usefulness.
- The table structure. Evaluation of the array structure.
- The structure of the Stack (Static and dynamic).
- The structure of the Queue (Static and dynamic).
- The structure of the Priority List and Queue.
- The Linked List structure single & double.
- The structure of the Tree. Binary Search Tree.
- The structure of the red-black Tree. 2-3-4 Tree.
- The structure of the Hash Table.
- The Heap structure.
- The structure of the Scripture.
- The classification algorithms.

Recap and compare structures.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom and lab.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Learning process support through the Moodle electronic platform. Laboratory training.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	39 hours
Individual Study	60 hours
Laboratory Exercise	26 hours
Course Total (25 hours per ECTS)	125 hours

STUDENT EVALUATION	For the successful examination of the course, the student must be successfully examined independently in both parts of the course, theory and laboratory. The evaluation in the theoretical part results from: 1. 35% the performance in individual assignments-online tests with multiple choice questions through the course page will be graded, 2. 65% of the final exams of the course with a comparative evaluation of theory elements. The assessment in the laboratory part results in: 1. active participation during the student's presence and work in the laboratory by 30%, 2. his/her final exam by 70%. The overall grade of the course is the weighted average of 60% the grade of the theoretical part and 40% of the laboratory.

RECOMMENDED BIBLIOGRAPHY

1. Data Structures & Algorithms in Java, Lafore Robert EDITIONS CH. GKIOURDA & Co EE. (Greek)
2. Data structures, algorithms and C++ applications, Sahnii Sartaj PUBLICATIONS A. TZIOLA & SONS S.A. (Greek)
3. DATA STRUCTURES, GEORGAKOPOULOS G.F. TECHNOLOGY & RESEARCH INSTITUTE PUBLICATIONS - UNIVERSITY PUBLICATIONS OF CRETE. (Greek)
4. Data structures & file organizations Ch. Koilias Publications of New Technologies. (Greek)
5. Data structures, Bozanis Panagiotis D. EDITIONS A. TZIOLA & SONS S.A. (Greek)

■ CE65 - Computational Statistics

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE65	**SEMESTER**	F
COURSE TITLE	COMPUTATIONAL STATISTICS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
The purpose of the course is the familiarity of the students with the use of statistical software and introduced in the principles of Computational Statistics. With this course, the students will be able to: • apply the most common methods of computational statistics, • use R programming language and SPSS statistical package for the above reason, • generate random numbers from both discrete and continuous distributions.
General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Decision making.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

R language is used. Introduction to R software environment. Variables-data. Data base connections. Programming with R language. Descriptive Statistics. Graphical Methods for data presentation. Hypothesis testing by use of R. Simulations. Generations of random numbers from discrete and continuous probability distributions. Monte Carlo integration. Visualization of classical results of statistical inference through simulating samples (e.g. asymptotic normality of sample mean, (1-α)100% CI, significance and p-value of a statistical test).

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours
Projects	20 hours
Individual Study	53 hours
Course Total (25 hours per ECTS)	125 hours

STUDENT EVALUATION	Projects 20%. Written final examination 80%.

RECOMMENDED BIBLIOGRAPHY

1. Ntzoufras I., Karlis D., Introduction to programming and statistical analysis with R, Hellenic Academi EBooks-"Kallipos" repository, 2015 (Greek). Available at: http://hdl.handle.net/11419/2601
2. Fouskakis D., Data analysis by use of R, Tsotras publications, 2013 (Greek).

3. Tsantas N., Moysiadis P. Mpagiatis K., Xantzipantelis T., Data analysis with the help of statistical software, Ziti publications, 1999 (Greek).

■ CE66 - Astronomy I

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE66	**SEMESTER**	F
COURSE TITLE	ASTRONOMY I		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	General Knowledge
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With the successful completion of the course the students will be able to: • know the basic tools, physical quantities as well as standard magnitude classes of astronomy, • know the radiation mechanism of celestrial bodies, • understand the basic physics of the Sun, • know the stellar structure, evolution and fate of stars, • know basic concepts of astronomy such as the movements of the Earth, spherical trigonometry, time, calendars, etc.

- study problems of Celestial Mechanics such as: Newtonian force fields, problem of two, three and N bodies,
- know how the Lagrange-Hamilton theory is applied to the problems of Celestial Mechanics.

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Decision making.
- Production of free, creative and inductive thinking.

CONTENT OF THE COURSE

Basic concepts of Astronomy. Movements of the Earth-planets. Astronomical coordinate systems, Stellar magnitudes and distances. Elements of Spherical Trigonometry. Time (counting and calendars). Solar system. Kepler's Laws, N-body Problems in Dynamical Astronomy and especially in Celestial Mechanics. Problems of Dynamical Astronomy. Final stages: white dwarfs, neutron stars and black holes. Overview of the Sun. Solar system. Variable and idiosyncratic stars. Star groups and clusters. Interstellar matter. Our galaxy. The other galaxies. Cosmology.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	e-Lectures. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours
Projects	42 hours
Individual Study	31 hours
Course Total (25 hours per ECTS)	125 hours

STUDENT EVALUATION	Projects 10%. Progress-exam 20%. Written final examination 70%.

RECOMMENDED BIBLIOGRAPHY

1. The universe that I loved, S. Theodosiou, Em. Danezis, Diavlos Publications. (Greek)
2. Introduction to modern astronomy, Ch. Varvoglis, I. Seiradakis, Agis-Savvas Gartaganis Publications. (Greek)
3. Astrophysics, Volumes I and II, F. Shu, Foundation for Technology and Research University Press of Crete. (Greek)

■ CE67 - Measure Theory

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE67	**SEMESTER**	F
COURSE TITLE	MEASURE THEORY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Infinite Calculus I-II-III-IV Real Analysis
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With the successful attendance of the course the students: • will be familiar with the notion of measure and its basic properties, • will be able to characterize basic sets as measurable or non measurable, • will be familiar with the notion of measurable function, • will understand the Lebesgue integral and will be able to compute it through a direct integration or the Riemann integral, • will learn the basic properties of the spaces L_p.

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Working independently for the enhancement of their self-esteem.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

- Algebra and σ-Algebra, measure (definition, properties, completion).
- Outer measures, Lebesgue measure, measurable and non measurable sets, Lebesgue measure and transformations, the Cantor set.
- Measurable functions and operations between them.
- Integral functions, Luzin Theorem, criteria of integration, comparison with Riemann integral.
- Spaces with measures. Tonelli and Fubini Theorems.
- Riesz Representation Theorem.
- Spaces L_p, (definition and properties).

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours
Individual Study	73 hours
Course Total (25 hours per ECTS)	125 hours

STUDENT EVALUATION	Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. Measure Theory, Koumoullis G. Negrepontis S., Publications Symmetria, 2005 (Greek).

2. Real Analysis, Xenikakis P., Publications Ziti, 1996 (Greek).
3. Introduction to Real Analysis, Betsakos D., Kyriakidi Press 2016 (Greek).

■ CE68 - Galois Theory

GENERAL

SCHOOL	SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE68	**SEMESTER**	F
COURSE TITLE	GALOIS THEORY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Algebra I
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With this course, the students will understand the theory of the rings of polynomials and their ideals. They will be able to use irreducible polynomials. They will understand the theory of fields, their extensions and the algebraic approach of geometric constructions. They will understand the Galois group, the Fundamental Theorem of Galois Theory, the solvable groups, the field of roots of polynomials and will study the solving of equations using radicals.
General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Working independently for the enhancement of their self-esteem.
- Creation of new research ideas.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

Rings, ideals (prime and maximal), Polynomial rings over fields, irreducible polynomials, Lemma of Gauss, criteria of irreducible polynomials.

Fields – Splitting fields, extensions of fields.

Galois group, roots of unity, Solvability by Radicals, Algebraic closed fields, Galois extensions. The Fundamental Theorem of Galois Theory, The Big Galois Theorem.

Applications: Cyclotomic polynomials, solvable groups, solving equations with radicals, regular polygons, Fundamental Theorem of Algebra. Ruler and Compass constructions.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class,. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours
Individual Study	73 hours
Course Total (25 hours per ECTS)	125 hours

STUDENT EVALUATION	Optional projects during the whole semester, with presentations. (bonus to the final grading) Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. D. Dummit, R. Foote, Abstract Algebra, 3rd edition, Wiley publications, 2004. (english)
2. J.Fraleigh, Introduction to Algebra, University Publications Crete, 2012 (Greek).
3. N.Marmaridis, Basic Galois Theory, Publications Kallipos, 2021 (Greek).
4. J.Rotman, Galois Theory, Publications Leader Books, 2000 (Greek).
5. Th. Theochari-Apostolidou and C. M. A. Charalambous, Galois Theory, Publications Kallipos, (2015). (Greek)

■ CE69 - Combinational and Graph Theory

GENERAL

SCHOOL	SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE69	**SEMESTER**	F
COURSE TITLE	COMBINATIONAL AND GRAPH THEORY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the students will be able to: • use special methods of Enumeration, Distribution, Divisions and Divisions, • use the properties of Graphs and Random Graphs to represent complex systems.
General Competencies
• Search for, analysis and synthesis of data and information, with the use of the necessary technology. • Individual work.

- Production of free, creative and inductive thinking.
- Work in an interdisciplinary environment.

CONTENT OF THE COURSE

ENUMERATION TECHNIQUES: Fundamental Principle of Enumeration, Permutations-Arrangements-Combinations, Binomial coefficients, Principle of Inclusion Exclusion, Perturbations, Principle of Pigeon or Dirichlet, Principle of Reflection, Movement in Networks, Lexicographic method of recording permutations.
SPECIAL SUBJECTS OF ENUMERATION: Pascal's triangle and Fibonacci numbers, Diophant equations and Partitions, Sorting problems (balls in cells, Stirling, Bell, Catalan numbers), Generating Functions.
GRAPHS: Basic Concepts (order, magnitude, connectivity, direction, neighbors, walk, path, circle, complement, bipartite, operations, degree, geodesic, distance, diameter, radius), Properties-Characteristic Tables (Theorems about degrees, isomorphism, connection tables, correspondences, gramogram), Subgraphs, paths, trees, factors, intersections, bridges, Theorems of Kirchoff, Dirac, Menger, Special Graphs (Planes, Euler, Hamilton, n-cubes, Gray codes, Ramsey numbers), Colorings (basic theorems, coloring polynomials, coloring algorithms).

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours
Individual Study	73 hours
Course Total (25 hours per ECTS)	125 hours

STUDENT EVALUATION	Optional projects during the whole semester, with presentations. (bonus to the final grading) Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

-Suggested Bibliography:

1. Mousiadis Pol. (2001): Applied Combinatorial. The art of counting without counting, Ed. ZITI, Thessaloniki. (Greek)

2. Discrete Mathematics, C.Athanasiadis, Publications Efaltirio, 2023. (Greek)

3. Discrete Mathematics, Kolountzakis M., Papachristodoulos C., Kallipos. (Greek)

4. Discrete Mathematics and their applications., Kenneth H. Rosen, 8th edition, Tziola Publications, 2018. (Greek)

5. Discrete Mathematics and their Applications, Susana S. Epp, Publications Kleidarithmos, 2010. (Greek)

- Additional Bibliography for study:

6. Béla Bollobás (2002). Modern Graph Theory. Springer.

7. West B.D. (2002). Introduction to Graph Theory.

8. Bondy J.A., Murty U.S.S.R. (2008). Graph Theory. Springer.

9. Diestel R. (2005). Graph Theory. Springer, NY.

10. Maarten van Steen (2010). Graph Theory and Complex Networks An Introduction. Maarten van Steen.

■ CE71 - Mathematical Physics

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE71	**SEMESTER**	G
COURSE TITLE	MATHEMATICAL PHYSICS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
The students who successfully complete this course will be able to: • understand basic mathematical theories and tools that are used in the study of differential equations in various branches of physics, • know modern-day techniques of symbolic computation to analytical approaches of physical problems, • handle problems with new data (various physical states, boundary conditions, etc.), • synthesize or find solution methods in new physical applications.

General Competencies
• Search for, analysis and synthesis of data and information, with the use of the necessary technology. • Decision making. • Production of free, creative and inductive thinking.

CONTENT OF THE COURSE

Basic introductory concepts in programming with symbolic programming languages. Basic operations and commands, functions, integrals, lists, diagrams. Introduction to Complex Analysis. Vector Spaces, Hilbert Spaces, Operators, Integral Transformations. Special Functions of Mathematics and Physics (Gamma function, Theta function, Zeta function). Differential Equations and their solution with a computer. Non-homogeneous Differential Equations. Green's method. Applications in Physics.

TEACHING AND LEARNING METHODS - EVALUATION

<table>
<tr><td>TEACHING METHOD</td><td>In the classroom.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Software Mathematica.
e-Lectures.
Use of e-class.
Communication through face-to-face discussions and e-mails.</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td>
<table>
<tr><th>Activity</th><th>Semester Workload</th></tr>
<tr><td>Lectures</td><td>52 hours</td></tr>
<tr><td>Projects</td><td>25 hours</td></tr>
<tr><td>Individual Study</td><td>73 hours</td></tr>
<tr><td>Course Total
(25 hours per ECTS)</td><td>150 hours</td></tr>
</table>
</td></tr>
<tr><td>STUDENT EVALUATION</td><td>Projects 10%.
Progress-exam 20%.
Written final examination 70%.</td></tr>
</table>

RECOMMENDED BIBLIOGRAPHY

1. Vergados J., Mathematical Methods of Physics, Vol. I, Crete University Press, 2004. (Greek)
2. Chow T., Mathematical Methods for Physicists: A concise introduction, Kleidarithmos Publications, 2018. (Greek)
3. Mathematical Methods of Physics, Volume A, Complex Functions, Fourier Analysis, S. Masen, M. Grypaios, Charalambos Publications Nik. Aivazis. (Greek)

CE72 - Numerical Solving of Differential Equations II

GENERAL

SCHOOL	SCIENCE		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE72	**SEMESTER**	G
COURSE TITLE	NUMERICAL SOLVING OF DIFFERENTIAL EQUATIONS II		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Numerical Solving of Differential Equations I
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
After successful completion of the course, the students will have acquired a very good knowledge in the subject of numerical solving of differential equations. They will have known the current trends in research in this subject.
General Competencies
• Introduction to scientific research

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Decision making.
- Production of free, creative and inductive thinking.

CONTENT OF THE COURSE

With this course students are introduced to scientific research. Numerical Solving of Differential Equations. They will study and present journal articles and write their own small project.
The course contents are Runge-Kutta, Runge-Kutta-Nystrom, Partitioned Runge-Kutta methods. Butcher's theory: class conditions. trees, construction methods. Stability of methods.
Methods for solving problems with specific properties of the solution: exponentially and trigonometrically fitted methods, methods with minimum phase lag, with minimum magnification error.
Two-step hybrid methods, second derivative methods.
Implementation with MATLAB.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Software MATLAB. e-Lectures. Use of e-class.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours
Programming Tasks in MATLAB	26 hours
Individual Study	47 hours
Course Total (25 hours per ECTS)	125 hours

STUDENT EVALUATION	Project 50%. Written final examination 50%.

RECOMMENDED BIBLIOGRAPHY

1. Z. Kalogiratou, Th. Monovasilis, Numerical Integration of Differential Equations, Kallipos Open Academic Editions, 2024. https://dx.doi.org/10.57713/kallipos-441. (Greek)
2. M. N. Vrachatis, Numerical Analysis: Ordinary Differential Equations, Kleidarithmos Pub. 2012 (Greek)
3. G.D. Akrivis, A.B.Dougalis, Numerical methods for Ordinary Differential Equations, Crete University Publications, 2015.
4. J. Buthcer, Numerical Methods for Ordinary Differential Equations. Wiley & Sons Publications, 2016.
5. J.R. Dormand, Numerical Methods for Differential Equations: A computational approach. CRC Press, 1996, (ebook 2017).

■ CE73 - Mathematical Programming

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE73	**SEMESTER**	G
COURSE TITLE	MATHEMATICAL PROGRAMMING		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With this course, the students: • will be able to solve integer linear programming problems, • will be able to find the main idea of dynamic programming, • will be able to solve classical optimization problems by use of dynamic programming, • will be able to consolidate the notion of stochasticity in optimization and decision problems.
General Competencies

- Search for, analysis and synthesis of data and information, by use of the necessary technology.
- Working independently for the enhancement of their self-esteem.
- Creation of new research ideas.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

Integer linear programming, integer programming problem modelling, integer programming algorithms, dynamic programming, deterministic path problems, equipment replacement, stochastic path problems, stochastic equipment replacement problems, the knapsack problem, the travelling salesperson problem.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	e-Lectures. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	**Activity** / **Semester Workload** Lectures: 52 hours Projects: 26 hours Individual Study: 72 hours Course Total (25 hours per ECTS): 150 hours
STUDENT EVALUATION	Projects 20%. Written final examination 80%.

RECOMMENDED BIBLIOGRAPHY

1. Vassiliou P.-C. G., Applied Mathematical Programming, Ziti Publications, 2001 (Greek).
2. Taha H., Operations research An introduction, Pearson, (10th ed), 2017.
3. Ypsilantis P. Operations research: Methods and techniques in decision making, Propompos publications, (5th ed), 2015 (Greek).

■ CE74 - Symbolic Programming Languages

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE64	**SEMESTER**	F
COURSE TITLE	SYMBOLIC PROGRAMMING LANGUAGE		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Skills Development
PREREQUISITE COURSES	Introduction to Programming
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With the successful completion of the course, the students: • will have acquired the knowledge of basic concepts of informatics, • will have become familiar with the use of computational algebra systems such as Mathematica to solve mathematical problems in all areas of mathematics, • will be able to design problem-solving algorithms, • will be able to present mathematical concepts to students in a more demonstrative way, • will have acquired necessary teaching skills for teaching computer science in high

school.

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Decision making.
- Production of free, creative and inductive thinking.

CONTENT OF THE COURSE

The course is included in the section of Special Teaching of Mathematic courses. An introduction to the use of informatics concepts suitable for presentations to junior high school students. Required laboratory course of a large number of compulsory courses. Introduction to systems of symbolic mathematical manipulations. The Mathematica language. Representation of symbolic mathematical expressions. Numerical calculations. Symbolic calculations. Symbolic manipulation of mathematical expressions. Basic functions. List and list manipulation. Functions, program flow control structures. Programming. Introduction to using additional packages. Create new packages. Study and didactic approach to the understanding of special topics from the areas of Algebra (expansion-factorization of expressions, simplification-transformation of expressions into equivalent simpler forms, tables, sets), Analysis (exact and numerical solutions of equations and systems of algebraic equations, differentiation, Taylor series, limits, integration, series) and Geometry (second order curves and surfaces, static and moving graphs). Use of other symbolic languages such as Maple, Reduce, Macsyma, Matlab. Comparison.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	e-Lectures. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	52 hours
Individual Study	98 hours

	Course Total (25 hours per ECTS)	150 hours
STUDENT EVALUATION	Programming tasks 30%. Written final examination 70%.	

RECOMMENDED BIBLIOGRAPHY

1. Karampetakis Nikolaos, Stamatakis Stylianos, Psomopoulos Evangelos, 2004, Mathematics and Programming in Mathematica, Ziti Publications. (Greek)
2. Papadakis Konstantinos E., 2010, Introduction to Mathematica, Tziola Publications. (Greek)
3. Stefanos Trahanas, 2004, Mathematica and applications, University Press of Crete. (Greek)
4. N. Glynou, Introduction to symbolic calculations with Mathematica, Ioannina 2002. (Greek)
5. S. Trachanas, 2001, Mathematica and Applications: For Mathematicians, Physicists and Engineers, University Press of Crete. (Greek)
6. John W. Gray, 1997, Mastering Mathematica: Programming methods and applications, Academic Press.
7. R.J. Gaylord, S.N. Kamin and P.R. Wellin, 1993, Introduction to Programming with Mathematica, Springer-Verlag.
8. Roman Maeder, 1991, Programming in Mathematica, Addison-Wesley Publishing Co., Second Edition.

■ CE75 - Statistical Data Analysis

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE75	**SEMESTER**	G
COURSE TITLE	STATISTICAL DATA ANALYSIS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon completion of the course the student will be able to: • enter data into the computer, • conduct descriptive statistical analysis, i.e. to summarize the available data, • conduct basic data analyzes (outlier testing, normality, basic hypothesis testing with dependent and independent samples, one-factor analysis of variance), • adapt linear models, mainly simple regression, checking whether or not the assumptions of their application are violated, • present the results of the above analyzes (reference report).

General Competencies
• Search for, analysis and synthesis of data and information, with the use of the necessary technology. • Individual work. • Production of free, creative and inductive thinking. • Work in an interdisciplinary environment.

CONTENT OF THE COURSE

In this course, the statistical theory developed in "Statistics I" is applied, with the help of the computer and the use of the statistical program SPSS. More specifically, it is applied to hypothesis testing concerning the mean value of a population, the mean values of two populations with dependent and independent samples, simple and multiple linear regression, as well as analysis of variance by one factor.

TEACHING AND LEARNING METHODS - EVALUATION

<table>
<tr><td>TEACHING METHOD</td><td>In the classroom.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Use of e-class.
Communication through face-to-face discussions and e-mails.</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td>
<table>
<tr><th>Activity</th><th>Semester Workload</th></tr>
<tr><td>Lectures</td><td>52 hours</td></tr>
<tr><td>Individual Study</td><td>73 hours</td></tr>
<tr><td>Solving exercises-Projects</td><td>25 hours</td></tr>
<tr><td>Course Total
(25 hours per ECTS)</td><td>150 hours</td></tr>
</table>
</td></tr>
<tr><td>STUDENT EVALUATION</td><td>Written final examination 100%.</td></tr>
</table>

RECOMMENDED BIBLIOGRAPHY

- Suggested Bibliography:

1. Exploring Statistics Using IBM SPSS, Andy Field.
2. A GUIDE TO DATA ANALYSIS WITH IBM SPSS 19, MARIJA J. NORUSIS.

- Additional bibliography for study:

1. Carver and Nash (2006). Doing data analysis with SPSS version 18.0 Coakes and Steed (1999).SPSS: Analysis Without Anguish.

■ CE76 - Set Theory

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE76	**SEMESTER**	G
COURSE TITLE	SET THEORY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	5

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With a successful attendance of the course, the students: • will understand basic notions of Set Theory such as the notions of set, subset, powerset and operations between sets, • will understand equivalence relations, order relations and functions between sets, • will understand the Axiomatic Foundation of Set Theory, paying attention to the axioms of Zermelo-Fraenkel and the Axiom of Choice, • will understand the foundation of the sets of natural numbers, integers numbers and rational numbers and also the notions of basic operations between these numbers,

- will understand the construction of the set of real numbers as Dedekinds cuts and through Cauchy sequences of rational numbers and also the notions of basic operations between these numbers,
- will understand the notion of countable set and properties of countable sets,
- will understand the notion of cardinal number, basic operations between them and their order,
- will understand the basic theory of ordinal types and ordinal numbers, studying operations between them and their order,
- will understand important subsets of the set of real numbers like the Cantor set, Borel sets and Baire sets,
- will understand the importance of Set theory through its applications in various branches of Mathematics.

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Working independently for the enhancement of their self-esteem.
- Creation of new research ideas.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

- Set, subset, powerset, operations between sets, like union and intersection, properties of these operations.
- Equivalence relations, equivalence classes, order relations, functions.
- Axiomatic Foundation of Set Theory by Zermelo-Fraenkel.
- Foundation of natural, integers and rational numbers, operations between these numbers, the order relation on the sets of natural, integers and rational numbers.
- Study of the set of real numbers through Dedekind cuts and Cauchy sequences of rational numbers, operations between these numbers, order relation on the set of real numbers.
- Countable and non-countable sets.
- Cardinal numbers, Cantor-Berstein theorem, operations between cardinal numbers, order between cardinal numbers, the continuum hypothesis.
- Ordinal types and ordinal numbers, operations between ordinal types and ordinal numbers, order between them.
- Important subsets of the set of real numbers, like the Cantor set, Borel sets and Baire sets.
- Applications of Set Theory in branches of Mathematics.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.

<table>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Use of e-class,.
Communication through face-to-face discussions and e-mails.</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td><table>
<tr><th>Activity</th><th>Semester Workload</th></tr>
<tr><td>Lectures</td><td>52 hours</td></tr>
<tr><td>Individual Study</td><td>98 hours</td></tr>
<tr><td>Course Total
(25 hours per ECTS)</td><td>150 hours</td></tr>
</table></td></tr>
<tr><td>STUDENT EVALUATION</td><td>Written final examination 100%.</td></tr>
</table>

RECOMMENDED BIBLIOGRAPHY

1. D. Georgiou, S. Iliadis, Set Theory, Publications Tziola, 2017 (Greek).
2. K. Kalfa, Axiomatic Set Theory, Publications Ziti, 1990 (Greek).

■ CE77 - Differential Geometry II

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE77	**SEMESTER**	G
COURSE TITLE	DIFFERENTIAL GEOMETRY II		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Infinitesimal Calculus I-IV Linear Algebra I-II Differential Geometry I
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the students: • will be able to define maps on a differentiable surface and check whether a representation is differentiable, • will be able to calculate the reciprocal derivative of a vector field, • will be able to calculate the geodesic curves of simple surfaces,

- will be familiar with basic surfaces of constant curvature.

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Individual work.
- Production of free, creative and inductive thinking.

CONTENT OF THE COURSE

Maps, local coordinate systems and manifold atlases. Basic examples.
Differentiable mappings between manifolds, differential mapping.
Vector fields, parallel transport, reciprocal derivative.
Function of length, geodesic curves, definition and examples.
Gauss-Bonnet theorem.
Surfaces of constant curvature.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	
STUDENT EVALUATION	Written final examination 100%.

Activity	**Semester Workload**
Lectures	52 hours
Individual Study	98 hours
Course Total (25 hours per ECTS)	150 hours

RECOMMENDED BIBLIOGRAPHY

1. B. Papantoniou, Differentiable manifolds, University Press of Patras, 2013 (Greek).
2. Barrett O' Neil, Elementary Differential Geometry, Third Edition, ITE Publications, University Press of Crete, 2005. (Greek)
3. A. Pressley, Elementary Differential Geometry, Third Edition, ITE Publications,

University Press of Crete, 2011. (Greek)
4. A. Arvanitoyeorgos, Elementary Differential Geometry, Association of Greek Academic Libraries, 2015. (Greek)

■ CE78 - Functional Analysis

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE78	**SEMESTER**	G
COURSE TITLE	FUNCTIONAL ANALYSIS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Topology
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With a successful attendance of the course, the students: • will understand the basic properties of the norm, • will understand the meaning of the completeness, • will learn for the classical Banach spaces and their basic properties, • will learn the basic theory of Hilbert spaces, • will learn the meaning of the bounded linear operators, • will understand the meaning of the binary space and apply related techniques,

- will learn the Hahn-Banach Theorem, Open mapping Theorem and Closed graph Theorem.

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Working in an interdisciplinary environment.
- Working independently for the enhancement of their self-esteem.
- Team Working.
- Creation of new research ideas.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

Basic properties of metric spaces. Banach spaces, basic properties and examples. Spaces with norm of finite dimension. Spaces with inner product and Hilbert spaces, basic notions, properties and examples, orthogonality. Bounded linear operators. Bounded linear functionals. Isomorphisms and isometries. Operator norm. The space of bounded operators as a Banach space. Dual space. Hahn-Banach Theorem, Banach-Steinhaus Theorem, Open mapping Theorem, Closed graph Theorem.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	40 hours
Lectures of auxiliary exercises	20 hours
Solving of selected exercises	40 hours
Individual Study	50 hours

	Course Total (25 hours per ECTS) — 150 hours
STUDENT EVALUATION	Written final examination (theory and exercises) 100%.

RECOMMENDED BIBLIOGRAPHY

1. S. Negrepontis, Th. Zachariadis, N. Kalamidas, V. Farmaki, General Topology and Function Analysis, Publications Symmetria, 1997 (Greek).
2. C. Karyofyllis, Elements of Functional Analysis, Publications Ziti, 1995 (Greek).
3. E. Kreyszig. *I*ntroductory Functional Analysis. Wiley, 1989.
4. G. F. Simmons. Introduction to Topology and Modern Analysis. Krieger Publishing Company, 2003.

■ CE79 - Artificial Intelligence

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE79	**SEMESTER**	G
COURSE TITLE	ARTIFICIAL INTELLIGENCE		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon completion of the course the student will be able to: • know the basic structures of search algorithms, • develop basic programming schemes of intelligent agents, • use knowledge representation methods with propositional and categorical logic, as well as with recursive rules, • use neural networks and evolutionary intelligence algorithms, • know the characteristics of an expert system.
General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Individual work.
- Promotion of free, creative and inductive thinking.
- Problem solving.
- Generating new research ideas.

CONTENT OF THE COURSE

Basic concepts. Historical data. Representation of problems. Algorithms (blind and directed) search. Knowledge, knowledge representation (logic, structured rules). Alternative reasoning (with uncertainty, with ambiguity). Knowledge systems. Action planning. Autonomous programs (agents) and distributed informatic systems. Non-symbolic logic (genetic algorithms, neural networks). Applications (natural language processing, machine vision, robotics).

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours
Individual Study	73 hours
Solving exercises-Projects	25 hours
Course Total (25 hours per ECTS)	150 hours

STUDENT EVALUATION	Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. Vlachavas I., Kefalas P., Vasiliadis N., Kokkoras F., Sakellariou H., Artificial Intelligence. (Greek)
2. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach. (Greek)

■ CE81 - Mathematical Modelling

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE81	**SEMESTER**	H
COURSE TITLE	MATHEMATICAL MODELLING		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the students will be able to: • know the basic stages for the construction of mathematical models, • know the meaning and importance of fundamental laws, such as the principle of conservation of mass, energy, etc., as well as the variables that appear in them, • use the fundamental laws for the production of simple mathematical models which will describe simple physical problems, e.g. one-dimensional flow in a cylindrical section, and other similar problems from chemistry, biology, etc., • know the concept of the functional, and the concept of the minimum for it, i.e.

introductory concepts of calculus of variations,
- define a functional and produce simple academic models such as Laplace equation,
- distinguish the various common academic problems that they encounter, e.g., P.O.E. first, second order, if they describe transport, diffusion, wave effects, etc.,
- know the basic steps for building mathematical models.

General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Indivisual work and also team work in an interdisciplinary environment
- Making decisions.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Introductory concepts, what is the mathematical model.
Iterative concepts and theorems of Infinite Calculus, eg, parametrization of particle motion, divergence theorem, concept of tensor.
Description in Euler and Lagrange coordinates.
Conservation laws in one dimension.
Conservation of mass, energy momentum.
Derivation of a quantity in a passage that varies with time.
Conservation laws in many dimensions, and with discontinuities.
Use of laws and production of simple mathematical models, examples.
What is functional, its derivatives, finding minima in simple-special cases,
Examples of mathematical models with the process of finding minima for functors.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Graphics and video software for representing natural phenomena. e-Lectues. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	52 hours
Exercises, study and search for results in bibliography	35 hours

	Individual Study: 63 hours Course Total (25 hours per ECTS): 150 hours
STUDENT EVALUATION	Projects, problem solving with a related search in the bibliography 30%. Written final examination 70%.

RECOMMENDED BIBLIOGRAPHY

1. Mathematical Modelling-A Study in the Natural Sciences, Stavros Komineas, Evangelos Charmandaris, Publisher: Association of Greek Academic Libraries.
2. A Primer on Mathematical Modeling, Alfio Quarteroni, Paola Gervasio Springer, freeLink.
3. Applied Mathematical Modeling of Engineering Problems, Natali Hritonenko, Yuri Yatsenko.
4. Applied mathematics, Logan David, Translation: Dougalis V., Mitsoudis D., Stratis I., Univ. Publications of Crete. (Greek)
5. Applied Numerical Methods with MATLAB for Engineers and Scientists, S. Chapra, (Awaiting Translation by G. Sisias, publications Tziola AE.). (Greek)
6. A. B. Taylor, Mathematical Models in Applied Mechanics, Oxford University Press (1984).
7. G. K. Batchelor, An Introduction to Fluid Dynamics (Cambridge University Press, Cambridge, 2000).
8. N. D. Fowkes J. J. Mahoney, An Introduction to Mathematical Modelling, John Wiley (1990).
9. K. F. Riley, M. P. Hobson and S. J. Bence, Mathematical Methods for Physics and Engineering (3rd edition, Cambridge University Press, 2006).
10. Mathematical Modeling, Christof Eck, Harald Garcke, Peter Knabner, Springer, 2017.

■ CE82 - Queuing Systems

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE82	**SEMESTER**	H
COURSE TITLE	QUEUING SYSTEMS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With this course, the students will be able to: • use Markov processes in queuing system modeling, • apply Little's results, • recognize and apply basic queuing system models, • employ queuing system models for optimal decision making.
General Competencies
• Search for, analysis and synthesis of data and information, with the use of the

necessary technology.
- Application of knowledge in practice.
- Decision making.
- Production of free, creative and inductive thinking for optimal decision making.

CONTENT OF THE COURSE

Description of queuing systems, basic notions and general results. Simple Markov systems. M/M/1 system: System states, waiting time, busy periods, departure process. Other Markov Systems: M/M/m/k, M/M/∞/∞, Erlang systems, bulk queues. M/G/1 system: system states, waiting time, busy period. Applications for optimal decision making.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Powerpoint presentations. Use of e-class. Communication through face-to-face discussions via e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	52 hours
Projects	26 hours
Individual Study	72 hours
Course Total (25 hours per ECTS)	150 hours

STUDENT EVALUATION	Projects 20%. Written final examination 80%.

RECOMMENDED BIBLIOGRAPHY

1. Fakinos D., Stochastic Models in Operations Research: Theory and Applications, Symmetria, 2007 (Greek).
2. Hillier F. S. & Lieberman G. J. Introduction to operations research (7th ed.). McGraw-Hill, 2001.
3. Stafylopatis A.-G. Performance analysis of computational systems, Hellenic Academic Ebooks- “Kallipos” repository, 2016 (Greek).

4. Fakinos D., Queuing systems, Symmetria, 2008 (Greek).

■ CE83 - Statistics II

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE83	**SEMESTER**	H
COURSE TITLE	STATISTICS II		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Statistics I
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With this course, the students will be able to: • study theoretical and applied statistical problems, • handle several Statistical Functions for parameter estimation, • delve into the theoretical background of hypothesis testing, • apply the fundamental Naymann-Pearson lemma for the configuration of hypothesis tests, • consolidate the theoretical framework on which all statistical methodologies and techniques are established.

General Competencies
• Search for, analysis and synthesis of data and information, with the use of the necessary technology. • Application of knowledge in practice. • Decision making.

CONTENT OF THE COURSE

Estimation: Unbiased, efficient and consistent estimators. Exponential distribution family. Search for minimum variance estimators with Rao-Blackwell and Cramer-Rao methods. Estimation methods (maximum likelihood, moment method, Minimax and Bayes). Confidence Interval parameter estimates. Hypothesis testing: The fundamental Naymann-Pearson lemma. Simple and complex hypothesis testing, generalized likelihood ratio test.

TEACHING AND LEARNING METHODS - EVALUATION

<table>
<tr><td>TEACHING METHOD</td><td>In the classroom.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Powerpoint presentations.
Use of e-class.
Communication through face-to-face discussions via e-mails.</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td>
<table>
<tr><th>Activity</th><th>Semester Workload</th></tr>
<tr><td>Lectures</td><td>52 hours</td></tr>
<tr><td>Projects</td><td>26 hours</td></tr>
<tr><td>Individual Study</td><td>72 hours</td></tr>
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</table>
</td></tr>
<tr><td>STUDENT EVALUATION</td><td>Projects 20%.
Written final examination 80%.</td></tr>
</table>

RECOMMENDED BIBLIOGRAPHY

1. Iliopoulos G., Basic Methods of Parameter Estimation, Ath. Stamoulis Publications, 2006 (Greek).
2. Kourouklis S., Parametric statistical inference issues, Hellenic Academic EBooks-“Kallipos” repository, 2016 (Greek).

3. Papaioanou T. and Ferentinos K., Mathematical Statistics, Ath. Stamoulis Publications, 2000 (Greek).
4. Kolyva-Mahera F., Mathematical Statistics-Estimation, Ziti publications, 1998 (in Greek).
5. Kolyva-Mahera F. and Hatzopoulos S., Mathematical Statistics-Estimation, Hellenic Academic EBooks- "Kallipos" repository, 2016 (in Greek).
6. Rao, C. R. (2008). Linear Statistical Inference and its Applications, 2nd edition. Wiley Series on Probability and Statistics.
7. Rice, J. A.(1994). Mathematical Statistics and Data Analysis, 2nd edition. Duxbury Press.
8. Roussas, G. (2003). An Introduction to Probability and Statistical Inference. Academic Press. An imprint of Elsevier Science.

■ CE84 - Mathematical Logic

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE84	**SEMESTER**	H
COURSE TITLE	MATHEMATICAL LOGIC		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Set Theory
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With the successful attendance of the course the students: • will learn the basic language of Propositional Calculus like propositions and connections, • will be able to check the truth values of a proposition, the tautology/contradiction and the equivalence of propositions, • will learn the regular forms, • will study proofs in the view of typical systems,

- will understand basic theorems of Compactness, Validity and Completeness in Propositional Logic,
- will learn the meaning of Boole Algebra and its applications,
- will be able to use the language of Categorical Logic,
- will understand basic theorems of Compactness, Validity and Completeness in Categorical Logic.

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Working independently for the enhancement of their self-esteem.
- Creation of new research ideas.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

- The language of Propositional Logic, the truth values of propositions, corresponding truth-matrices, tautologies, contradictions, logic equivalence of propositions.
- Adequacy of logic connections, regular forms.
- Systems of typical proofs.
- Logic circuits, Algebra Boole.
- The language of Categorical Logic.
- The theorems of Compactness, Validity and Completeness in Categorical Logic.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours
Individual Study	98 hours
Course Total (25 hours per ECTS)	150 hours

STUDENT	Written final examination 100%.

EVALUATION	

RECOMMENDED BIBLIOGRAPHY

1. Margaris A. I., Introduction to Mathematical Logic, Publications Tziola, 2017 (Greek).
2. Tzouvaras Ath., Elements of Mathematical Logic, Publications Ziti, 1998 (Greek).
3. Georgiou D., Iliadis S., Set Theory, second edition, Publications Tziola, 2017 (Greek).
4. Cornelia Kalfa, Axiomatic Set Theory, Zetis Publications, 1990.
5. Enderton Herbert B., A Mathematical introduction to Logic, University Publications Crete, 2013 (Greek).

■ CE85 - Operator Theory

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE85	**SEMESTER**	H
COURSE TITLE	OPERATOR THEORY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Functional Analysis Topology
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the student will be able to: • understand the concept of bounded/unbounded operator on a normed space, as well as the notion of operator norm, • prove that an operator is bounded and compute or estimate its norm, • know various categories of operators in Hilbert spaces (self-adjoint, positive, projection, etc.) through examples but also through theoretical characterizations of an algebraic and geometric nature,

- distinguish between the different categories of operators, either in general or in specific spaces,
- know the relationships between (orthogonal) projections (orthogonality, order, commutativity, pointwise convergence of sequences) and be able to use these in solving problems,
- know the concept of finite rank operator and compact operator and the relationship between these categories as well as their various characterizations,
- understand the Spectral Theorem for compact normal operators in Hilbert spaces and the diagonalization of such operators, as well as the general form (polar representation) of compact operators in Hilbert spaces,
- apply the spectral theory of compact operators to problem solving.

General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Adapting to new situations.
- Working in an interdisciplinary environment.
- Independent work.
- Team work.
- Generation of new research ideas.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Euclidean spaces, inner products in infinite-dimensional spaces. Completeness, Hilbert spaces, basic properties, Closed operators, Examples, the conjugate operator, classes of operators, projections. Operators of finite order, compact operators, integral operators, diagonalization of operators, the spectral theorem for compact normal operators, Applications.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	e-Lectures. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	40 hours

	Teaching of exercises: 20 hours Solving of selected exercises: 40 hours Individual Study: 50 hours Course Total (25 hours per ECTS): 150 hours
STUDENT EVALUATION	Written final examination (100%) which includes: -Theory, -Exercises.

RECOMMENDED BIBLIOGRAPHY

1. Karanasios S., Theory of Operators & Applications, Publications Tsotras, 2nd ed., 2017. (Greek)
2. Katavolos A., Introduction to Operator Theory, Publications Symmetry, 2008. (Greek)
3. Ifantis E.K., Theory of Operators, Publications Stamoulis, 2004. (Greek)
4. Gohberg I., Goldberg S., Basic Operator Theory, Birkhäuser, 2001.
5. Kehe Zhu, Operator theory in Function Spaces, American Mathematical Society, 2nd edition, 2007.
6. Y. Abramovic, C. Aliprantis, An Invitation to Operator Theory, American Mathematical Society, 2002.
7. R.G. Douglas, Banach Algebra Techniques in Operator Theory, Springer- Verlag, 1998.

■ CE86 - Algebraic Geometry

GENERAL

SCHOOL	SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE86	**SEMESTER**	H
COURSE TITLE	ALGEBRAIC GEOMETRY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Algebra I
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
After successful completion of the course the student: • will have understood the problems with which Algebraic Geometry deals and its main goals, • will have studied and understood fundamental theorems of Algebraic Geometry, such as Nullstellensatz Theorems (Weak and Hilbert's Theorem), Bezout Theorem, Riemann-Roch Theorem.

- will understand the notions of an affine variety, projective and tangent space.

General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Individual work.
- Generation of new research ideas.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Affine varieties, the Zariski topology, ideals of affine varieties. Radical ideals, Weak Nullstellensatz Theorem, Hilbert's Nullstellensatz, zero-dimensional ideals.

The projective space, relations between affine and projective spaces, projective algebraic sets, ideals of projective algebraic sets.

Affine, algebraic and projective varieties, dimension of affine varieties.

Tangent space and smooth points. Bezout's Theorem and its applications. Curves, degree and genus of projective curves. The Riemann-Roch Theorem and its applications.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	52 hours
Individual Study	98 hours
Course Total (25 hours per ECTS)	150 hours

STUDENT EVALUATION	Optional projects during the whole semester, with presentations. (bonus to the final grading) Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. D. Dummit, R. Foote, Abstract Algebra, 3rd edition, Wiley publications, 2004. (English)
2. Poulakis D., Algebraic Geometry, Ziti Publications, 2018. (Greek)
3. Perrin D., Algebraic Geometry, An introduction, Springer, 2008. (English)
4. Shafarevich, Igor R., Basic algebraic geometry 1, Varieties in Projective Space, Springer, 2013. (English)

■ CE87 - Special Math Subjects II

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE87	**SEMESTER**	H
COURSE TITLE	SPECIAL MATH SUBJECTS II		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field Skills Development
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the students: • will have delved into a subject, • will have become familiar with specific scientific problems, • will have gained experience in how to write a scientific paper.
General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Decision making.
- Production of free, creative and inductive thinking.

CONTENT OF THE COURSE

The subject of the course is the knowledge of the supervisor who undertakes to guide a student or a group of students in the preparation of an assignment. The aim is to familiarize the student with specific scientific problems and to gain experience in how to write a scientific paper.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	Face-to-Face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Software MATLAB. e-Lectures. Use of e-class.
TEACHING ORGANIZATION	**Activity** / **Semester Workload** Individual Study / 150 hours Course Total (25 hours per ECTS) / 150 hours
STUDENT EVALUATION	Project 100%.

RECOMMENDED BIBLIOGRAPHY

The bibliography is determined by the supervisor.

■ CE88 - Multimedia Technology

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE88	**SEMESTER**	H
COURSE TITLE	MULTIMEDIA TECHNOLOGY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Skills Development
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
The aim of the course is to familiarize students with the basic concepts governing multimedia technologies, as well as their organized contact with techniques and tools used to create, develop and complete modern multimedia applications and digital games (video games). With the successful completion of the course, the student will be able to: • understand the basic concepts related to Multimedia Technologies, • understand the special characteristics, standards and technologies related to the various means of information representation (Text, Image, Sound, Animation,

Video) and become familiar with their basic coding techniques in multimedia applications,
- become familiar with the tools and special software for creating multimedia applications,
- become familiar with multimedia project management and development methodologies and how they are used to ensure the successful completion of multimedia applications,
- distinguish the key roles in a real project or multimedia application case study and appreciate the role of stakeholders in project implementation,
- identify the particular problems that arise during the development of multimedia applications and study ways of solving them,
- understand the network requirements of multimedia systems as well as the switching and playback technologies of multimedia applications on the Internet with a guaranteed quality of service,
- collaborate with fellow students to create and present a case study of an interactive multimedia application.

General Competencies

- Independent Work.
- Team work.
- Project Planning and Management.
- Criticism and self-criticism.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

The course is an introduction to methods, tools and techniques for creating and manipulating multimedia content (text, hypertext, voice, sound, graphics, images and video), for content retrieval and for multimedia communications. It includes issues of algorithms, standards, and protocols underlying multimedia signal and multimedia information handling techniques and multimedia communications. It focuses on presenting the concepts and characteristics of multimedia systems, describes the media that make up multimedia applications, analyzes theories and techniques for transforming media into a digital format suitable for processing, and finally lists requirements and techniques for transitioning multimedia applications to the Internet. Subsequently, methodologies for designing, developing, and implementing multimedia applications, including digital games, are taught.

Through laboratory exercises and practical exercises, as well as team work, the concepts of theory are applied in practice, which cover the material extensively.

More specifically, the content of the course covers the following topics:

- Introduction. What is multimedia? Structure, general characteristics and properties of Multimedia Systems. Classifications of Multimedia Systems and Applications. Interaction and Interactive Multimedia. Hypermedia. Structure and key features Adaptive Hypermedia Systems, Hypermedia in Education.
- Digital representation of Information. Digitization techniques.

- Basic methods of signal compression/coding. Coding principles and data compression techniques. Lossy and lossless compression algorithms. Entropy and source coding. Categories of compression methods. Text, Image, Audio, Animation and Video Compression Techniques (JPEG, MPEG).
- Digital Text. Representation, input, editing and printing of text. Markup Languages. Text and multimedia applications.
- Digital Image. Color representation and color models. Basic concepts of digital imaging. File types of bitmap images and vector graphics. Image capture and digitization. Image compression techniques. Digital image processing and vector graphics.
- Digital Audio. Sound characteristics. Audio capture and digitization. Digital Audio File Types. Coding methods and audio compression techniques. Audio and multimedia applications. MIDI. Digital audio processing. Digital Audio Sharing.
- Digital Video. Basic Video and Broadcast Video Features. Video capture and digitization. Video sampling and quantization. Digital video file types. Video file compression techniques (MPEG). Video coding standards (H.264, H.265). Video retrieval and playback. Digital video editing. Digital video sharing.
- 2-D and 3-D graphical and synthetic animation (design animation). Principles of Animation, 2-D graphic and synthetic movement (2D animation). 3-D graphic and synthetic movement (3D animation). Applications of 3D animation. Virtual Reality (Virtual Reality). Augmented Reality.
- Development of Multimedia Applications. Work phases (Analysis, Design, Production, Control/Evaluation, Distribution). Production group. Multimedia Application Development Methodology and Tools. Resource Management in Multimedia Systems.
- Multimedia and Internet. Distributed Multimedia Systems. Multicast and media streaming technology. Online distribution of multimedia content. Network services and protocols for multimedia communications. Video conference. Best effort services and guaranteed service quality. Transmission of multimedia content via 4G/5G mobile networks.

TEACHING AND LEARNING METHODS - EVALUATION

<table>
<tr><td>TEACHING METHOD</td><td>In the classroom and computer lab.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Use of specialized software for editing and writing multimedia applications.
Use of e-class.
Communication through face-to-face discussions and e-mails.</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td><table><tr><th>Activity</th><th>Semester Workload</th></tr><tr><td>Lectures</td><td>26 hours</td></tr></table></td></tr>
</table>

	<table><tr><td>Laboratory Exercises</td><td>26 hours</td></tr><tr><td>Small indivisual works</td><td>15 hours</td></tr><tr><td>Team project</td><td>13 hours</td></tr><tr><td>Individual Study</td><td>70 hours</td></tr><tr><td>Course Total (25 hours per ECTS)</td><td>150 hours</td></tr></table>
STUDENT EVALUATION	Written final exam (100%) in the Greek language, which includes: -Multiple choice test, -Short Answer Questions, -Problem solving, -Comparative evaluation of theory elements. During the semester, five individual assignments, as well as a larger group case study assignment covering several subject areas simultaneously, are given to students.

RECOMMENDED BIBLIOGRAPHY

1. Multimedia Use and Programming, 3rd Edition, Yue-Ling Wong, Gkiourda Publications, Athens, 2018. (Greek)
2. Multimedia Technology: Modern Multimedia Tools, G. Styliaras, V. Dimou, D. Zeugolis, Tziola Publications, Thessaloniki, 2019. (Greek)
3. Multimedia Analytical Guide, 8th Edition, Tay Vaughan, Gkiourda Publications, Athens, 2012. (Greek)
4. Multimedia Systems, Algorithms, Standards & Applications, Parag Havaldar & Gerard Medioni, Broken Hill Publishers LTD, Nicosia, 2012.
5. Multimedia Technology: Theory and Practice, S.N. Dimitriadis, A.S. Pomportsis & E.G. Triantaphyllou, Tziola Publications, Thessaloniki, 2004. (Greek)
6. Multimedia Technology and Multimedia Communications, G.B. Xylomenos & G.K. Polyzos, Kleidarithmos Publications, Athens, 2009. (Greek)
7. Multimedia Technologies: Theory, Hardware, Software, F. Lazarinis, Kleidarithmos Publications, Athens, 2007. (Greek)

■ CE89 - Computer Graphics

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE89	**SEMESTER**	H
COURSE TITLE	COMPUTER GRAPHICS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Skills Development
PREREQUISITE COURSES	Introduction to Programming Linear Algebra I-II
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
The course aims to familiarize students with the basic concepts of computational graphics, modeling of 2D and 3D objects, application of geometric algorithms/computational geometry, linear algebra and techniques in graphics, development of simple applications using basic algorithms, and using graphical programming interfaces to access the hardware. Upon successful completion of the course, the student will be able to: • understand the basic concepts related to Computer Graphics,

- understand the basic concepts and operations of vectors, matrices, signs and the relationships between them,
- be familiar with coordinate systems and their use in graphics, line and ellipsoid algorithms, frame and depth memories,
- understand the basics of color models and their variations, as well as the effects of different choices on each other,
- become familiar with the basic geometric transformations in 2 and 3 dimensions,
- understand and apply 2D and 3D object modeling techniques,
- be familiar with the practical use of the concepts of inner and outer products, perpendicular vectors, vector normalization, locating visible surfaces, and tilting surfaces with respect to light sources.
- understand the orthogonal, side-parallel and perspective projections of objects in space,
- become familiar with basic lighting models, camera parameters, as well as photorealistic techniques based on ray tracing and emitted radiation methods,
- collaborate, where appropriate, with fellow students to create and present simple applications that demonstrate the concepts of each module.

General Competencies

- Independent Work.
- Team work.
- Project Planning and Management.
- Criticism and self-criticism.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

The course presents fundamental concepts of graphics, both for 2 and 3 dimensions. Basic concepts of linear algebra and computational geometry are covered for modeling objects in 2D or 3D space. There is an extensive description of the techniques of applying basic transformations, as well as calculating the necessary elements for lighting and determining the visibility of objects. Lighting models are covered, combined with the visible surfaces. The various views used in practice are analyzed. Photorealistic rendering techniques are introduced, which are used both in motion graphics and now in original real-time form. In this context the concept of energy transfer in space is covered.

More specifically, the content of the course covers the following:

Section 1: Concept of vector and point. Operations between vectors and vectors and points. Calculation of inner and outer products. Vector normalization. Vector view. Relationship of inner products and normalization with angles. Relationship of outer factors with left-handed and right-handed systems. Coordinate reference systems. 3x3 and 4x4 matrices. Actions between matrices and matrices-points.

Section 2: Basic color models and actions that reduce color depth. The effects of various options on models and color depths.

Section 3: Frame and depth memories. Mesh description of line segments and

ellipsoids. Relationship between visible and active frame memories. Using depth memory to calculate the visible elements of visualizations.
Section 4: Modeling objects in 2 and 3 dimensions. Lattice model descriptions and parametrics. Description of models based on points/seats and points/sides/seats. Perpendicular vectors of vertices and bases, and use of outer products and Gouraud's method.
Section 5: Basic geometric transformations in 2 and 3 dimensions such as scaling, translation, rotation, warping. Matrix concatenation and complex geometric transformations. Orthogonal, side-parallel and perspective views of spatial objects.
Section 6: Clipping geometric descriptions outside the truncated cone of vision and non-visible seats.
Section 7: Lighting models such as ambient lighting, diffuse lighting, specular lighting, Phong model, intensity fading, spotlights. Refraction and transparent or semi-transparent materials. Surface slope and lighting.
Section 8: Photorealistic graphics with techniques based on casting and ray tracing, as well as emitted radiation.

TEACHING AND LEARNING METHODS - EVALUATION

<table>
<tr><td>TEACHING METHOD</td><td>In the classroom and computer-lab.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Use of specialized software for editing and writing computer graphics applications.
Use of e-class.
Communication through face-to-face discussions and e-mails.</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td>
<table>
<tr><th>Activity</th><th>Semester Workload</th></tr>
<tr><td>Lectures</td><td>26 hours</td></tr>
<tr><td>Laboratory Exercises</td><td>26 hours</td></tr>
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</table>
</td></tr>
<tr><td>STUDENT EVALUATION</td><td>Written final exam (100%) which includes:
-Short answer questions,</td></tr>
</table>

	-Problem solving, -Optional exercises and tasks, individual or group, -Comparative evaluation of theory elements. During the semester, individual assignments or group exercises and assignments, as well as a larger optional group assignment covering several subject areas simultaneously, are given to students.

RECOMMENDED BIBLIOGRAPHY

1. Hearn D and Baker MP. 2018. Computer Graphics with OpenGL. 3rd Improved Edition. Greece, Tziola Publications.
2. Theoharis T, Papaioannou G, Platis N and Patrikalakis NM. 2015. Graphics and Visualization: Principles and Algorithms. Greece, Symmetria Publications.
3. Akenine-Möller T, Haines E, Hoffman N. 2018. Real-Time Rendering. 4th ed. USA, A K Peters/CRC Press.
4. Hughes JF, van Dam A, McGuire M, Sklar DF, Foley JD, Feiner SK and Akeley K. 2013. Computer Graphics: Principles and Practice. 3rd ed. USA, Addison-Wesley.
5. Lengyel E. 2011. Mathematics for 3D Game Programming and Computer Graphics. 3rd ed. USA, Cengage Learning PTR.
6. Dunn F and Parberry I. 2011. 3D Math for Game Development. 2nd ed. USA, A K Peters/CRC Press.
7. Kessenich J, Sellers G and Shreiner D. 2016. OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.5 with SPIR-V. USA, Addison-Wesley.
8. Luna FD. 2016. 3D Game Programming with DirectX 12. USA, Mercury Learning & Information.
9. Haines E and Akenine-Möller T. 2019. Ray Tracing Gems: High-Quality and Real-Time Rendering with DXR and Other APIs. USA, APress.
10. Pharr M, Humphreys G and Jakob W. 2016. Physically Based Rendering: From Theory to Implementation. 3rd ed. USA, Morgan Kaufmann Publishers Inc.
11. Nystrom R. 2014. Game programming patterns. UK, Genever Benning.

■ CE710 - Special Math Subjects I

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE710	**SEMESTER**	G
COURSE TITLE	SPECIAL MATH SUBJECTS I		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field Skills Development
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, students: • will have delved into a subject, • will have become familiar with specific scientific problems, • will have gained experience in how to write a scientific paper.
General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Decision making.
- Production of free, creative and inductive thinking.

CONTENT OF THE COURSE

The subject of the course is the knowledge of the supervisor who undertakes to guide a student or a group of students in the preparation of an assignment. The aim is to familiarize the student with specific scientific problems and to gain experience in how to write a scientific paper.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	Face-to-Face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Software MATLAB. e-Lectures. Use of e-class.
TEACHING ORGANIZATION	**Activity** / **Semester Workload** Individual Study / 150 hours Course Total (25 hours per ECTS) / 150 hours
STUDENT EVALUATION	Project 100%.

RECOMMENDED BIBLIOGRAPHY

The bibliography is determined by the supervisor.

■ CE711 - Theory of automata and formal languages

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE711	**SEMESTER**	G
COURSE TITLE	THEORY OF AUTOMATA AND FORMAL LANGUAGES		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Skills Development
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
• Introductory Concepts: Automata, Computability, Complexity, Concepts, Definitions, Theorems, Proofs and Types of Proofs. • Abstract Machines and Languages: Introduction, the Elementary Machine (EM). Finite State Machines (FSM). Finite Automaton (FA), Causative Finite Automaton (CFA), Non-Acausative Finite Automaton (NAFA), Acceptance Trees (AT), Finite Automata with e-Transitions (FAWET), Equivalence of NAFA and FAWET, Minimization of a CFA, Repeatability Theorem, • Finite Automata and Grammars, Chomsky Hierarchy Grammars, Regular Sets (RS),

Regular Sets and Finite Automata, Finding the Regular Expression of a FA, Capabilities and Deficiencies of FAs.

- Stacked Finite Automata (SFA), Non-Acausal Finite Stacked Automata (NAFSA), Causative Finite Stacked Automata (CFSA), Acceptance with Empty Layer, Equivalence of SAF and Context-Independent Languages.
- Turing Machines (TM), Introduction, Mathematical Description, Useful Tricks for TM Construction, TM Modifications, TM as a Process.
- Unsolvability, the Church-Turing Theorem, Universal TM, the Termination Problem. Computational Complexity, NP-completeness.

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Decision making.
- Production of free, creative and inductive thinking.

CONTENT OF THE COURSE

Familiarity with:

- Abstract Machines and Languages: Introduction, Elementary Machine (EM), Finite State Machines (FSM). Finite Automaton (FA), Causative Finite Automaton (CFA), Non-Acausative Finite Automaton (NAFA), Acceptance Trees (AT), Finite Automata with e-Transitions (FAWET), Equivalence of NAFA and FAWET, Minimization of a CFA, Repeatability Theorem,
- Finite Automata and Grammars, Chomsky Hierarchy Grammars, Regular Sets (RS), Regular Sets and Finite Automata, Finding the Regular Expression of a FA, Capabilities and Deficiencies of FAs,
- Stacked Finite Automata (SFA), Non-Acausative Stacked Finite Automata (NASFA), Causative Stacked Finite Automaton (CSFA), Acceptance with Empty Layer, Equivalence of SFA and Context-Independent Languages,
- Turing Machines (TM), Introduction, Mathematical Description, Useful Tricks for Constructing TM, Modifications of TM, TM as a Process,
- unsolvability, the Church-Turing Theorem, Universal TM, the Termination Problem. Computational Complexity, NP-completeness.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	**Activity** | **Semester Workload**

	Lectures: 52 hours Individual Study: 98 hours Course Total (25 hours per ECTS): 150 hours
STUDENT EVALUATION	Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. Elements of computation theory, Lewis Harry R., Papadimitriou Christos Ch. (Greek)
2. INTRODUCTION TO THE THEORY OF COMPUTATION, SIPSER MICHAEL.

■ CE712 - Econometrics

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE712	**SEMESTER**	G
COURSE TITLE	ECONOMETRICS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	General Knowledge
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With the successful completion of the course, the students will acquire knowledge and skills that will enable them to: • design and estimate a linear regression model, • use an econometric software package (e.g. E-views) in the application of econometric techniques, • evaluate econometric models and their results, • evaluate results of diagnostic tests.
General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Decision making.
- Criticism exercise.
- Production of free, creative and inductive thinking.

CONTENT OF THE COURSE

Econometrics as a subject is based on the sciences of Economics, Statistics and Mathematics. Its purpose is the measurement and empirical control of economic relationships. The course aims to familiarize students with the use of econometric techniques to estimate economic models using econometric software packages (eg E-Views).

Suggested course material:

- Introduction to econometrics.
- Single equation regression models.
  - Bi-variate regression model: Basic ideas, model estimation, the method of least squares (OLS), coefficient of determination.
  - Classical normal linear regression model (CNLRM).
  - Bi-variate regression: interval estimation and hypothesis testing.
  - Extensions of the Bi-variate Linear Regression Model.
  - Multiple regression analysis: The problem of estimation, The problem of induction.
  - The use of dummy variables.
- Violation of assumptions of the classical model and residual diagnostic tests.
  - Normality.
  - Multicollinearity.
  - Heteroscattering.
  - Autocorrelation.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	PowerPoint presentations. Learning process support through the e-class electronic platform. Communication via e-mail and course discussion group. Use of econometric software (eg E-views).
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours

	<table><tr><td>Individual Study</td><td>98 hours</td></tr><tr><td>Course Total (25 hours per ECTS)</td><td>150 hours</td></tr></table>
STUDENT EVALUATION	1. Written final exam (50%) which includes: 1.1. Multiple choice questions. 1.2.Evaluation of theory elements. 1.3. Solving Exercises. 2. Group Laboratory work (50%) Remarks: The evaluation process and evaluation criteria will be posted on the course website in the e-class.

RECOMMENDED BIBLIOGRAPHY

-Suggested Bibliography:

1. Gujarati D., (2012), Econometrics, Principles and Applications, A. TZIOLA & SONS PUBLICATIONS S.A. (Greek)
2. Dritsaki, Ch., and Dritsaki, M., (2013), Introduction to econometrics using EViews software, Publications KLEIDARITHMOS Ltd. (Greek)
3. Wooldridge J., (2011) Introduction to econometrics, A. PAPAZISIS PUBLICATIONS SOLE PRIVATE EQUITY COMPANY. (Greek)

-Indicative list of related scientific journals:

1. Econometrica
2. Journal of Econometrics
3. Econometric Reviews
4. Quantitative Finance
5. Journal of Empirical Finance
6. Econometrics Journal
7. Journal of Applied Econometrics
8. Advances in Econometrics
9. Journal of Time Series Econometrics
10. Econometrics (MDPI)
11. Foundations and Trends in Econometrics
12. International Journal of Computational Economics and Econometrics
13. Applied Financial Economics

■ CE713 - Introduction to Macroeconomic Theory

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE713	**SEMESTER**	G
COURSE TITLE	INTRODUCTION TO MACROECONOMIC THEORY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	General Knowledge
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Course aim: understanding the functioning of a closed (no trade with other countries) economy. The main macroeconomic parameters are examined and the basic operating model of a closed economy is presented. Aim: The tools of basic analytical techniques are given to students in order to function effectively as active participants in the ever-changing world in which we live. Economics is a way of thinking about solving problems, not a set of ready-made answers ready to be taken off the shelf. Therefore, the main objective of the course is to help students develop systematic, critical and independent thinking of today's

macroeconomic problems.
General Competencies
Understanding and deepening the functioning of the closed economy and exercising economic policy.

CONTENT OF THE COURSE

- Basic concepts of macroeconomics. The aims and means of macroeconomics.
- Measurement of economic activity: gross domestic product, real and nominal GDP, price indices and inflation.
- Consumption, income, and saving. The consumption and saving functions, the marginal propensity to consume and save. The determinants of investment. The demand function for investment.
- The basic model of the income multiplier. The determination of output, with saving and investment, determination of output from consumption and investment, analysis of the income multiplier model. Fiscal policy, in the multiplier model. How government fiscal policies affect output and the fiscal policy multiplier.
- Money and interest.
- The operation of the central bank.
- The total offer.
- Inflation and unemployment.
- Macroeconomic policies.

TEACHING AND LEARNING METHODS - EVALUATION

<table>
<tr><td>TEACHING METHOD</td><td>In the classroom.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Powerpoint presentations.
Use of e-class.
Communication through face-to-face discussions and e-mails.</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td>
<table>
<tr><th>Activity</th><th>Semester Workload</th></tr>
<tr><td>Lectures</td><td>52 hours</td></tr>
<tr><td>Individual Study</td><td>98 hours</td></tr>
<tr><td>Course Total
(25 hours per ECTS)</td><td>150 hours</td></tr>
</table>
</td></tr>
<tr><td>STUDENT</td><td>Optional Midterm assessment which receives 30% of</td></tr>
</table>

EVALUATION	the grade. Written final exam including multiple choice questions.

RECOMMENDED BIBLIOGRAPHY

1. Papadogonas Th., (2019), Introduction to Macroeconomic Analysis and Policy, Athens: Tsotras. (Greek)
2. Katseli Louka T., Magoula Chara M., (2005), Macroeconomic analysis and the Greek economy, Athens: Dardanos. (Greek)

■ CE714 - Astronomy II

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE714	**SEMESTER**	G
COURSE TITLE	ASTRONOMY II		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	General Knowledge
PREREQUISITE COURSES	Astronomy I
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course the students will be able to know: • the basic principles governing astronomical observations and the operating principles of telescopes (optical, infrared, ultraviolet, X-rays, radio), • the sources of astronomical information and observable quantities, • the effect of the Earth's atmosphere on observations (absorption and disturbance) as well as the ways to deal with them, • the methods of spectroscopic analysis of radiation and the relevant instruments (spectrographs, filters, etc.),

- the polarization of radiation,
- the detection of particles (neutrinos, cosmic rays, particles in interplanetary space) and gravitational radiation,
- the physical processes that shape the phenomena in our own and other galaxies as well as the study of the evolution of the large-scale structures of the universe and the universe as a whole,
- galaxy clusters and superclusters.

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Decision making.
- Production of free, creative and inductive thinking.

CONTENT OF THE COURSE

Part A: Astronomical observation, Effect of atmosphere, Telescopes (Optical, Radio, Infrared, X-ray), Radiation detection methods, Charge transport systems, CCD camera, Spectral analysis of radiation, Polarization of radiation, Cosmic radiation.
Part B: Star Clusters and Stellar Evolution, Dynamical Evolution of Star Clusters, Galaxy Clusters-Large Structures, Variable Stars, Binary Star Systems, Interstellar Matter, Matter Infall and Active Galaxies.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	e-Lectures. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours
Projects	42 hours
Individual Study	56 hours
Course Total (25 hours per ECTS)	150 hours

STUDENT	Projects 10%.

EVALUATION	Progress-Exam 20%. Written final examination 70%.

RECOMMENDED BIBLIOGRAPHY

1. Galactic and Extragalactic Astrophysics, N. Alexandros, K. Alyssandrakis, Greek Academic Electronic Books and Aids.
2. Observational Astrophysics, K. Alyssandrakis, Greek Academic Electronic Books and Aids.
3. Astrophysics II course notes, A. Mastichiadis, M. Kontizas. (Greek)
4. Observational Astronomy, S. Avgoloupis, I. Seiradakis, D. Tsampouras Publications & Co. OE. (Greek)

■ CE810 - Digital Signal Processing

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE810	**SEMESTER**	H
COURSE TITLE	DIGITAL SIGNAL PROCESSING		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	2	6
Lab	2	

COURSE TYPE	Skills Development
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With the successful completion of the course, the student will be able to: • identify and describe digital signals and systems, • appreciate the advantages of digital signals over analogue ones, • plan the steps of signal analysis and processing, • recognize the transformations and apply them appropriately, • create applications in Matlab of appropriate signal management.
General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies, Adaptation to new situations.
- Making decisions.
- Independent work.
- Team work.
- Criticism and self-criticism.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

- Introduction to Signals.
- Digital signal processing tools.
- Fourier series and Fourier transform.
- Discrete time systems.
- System response-convolution.
- Sampling of Continuous Time signals.
- The Shannon-Nyquist Sampling Theorem.
- Discrete Fourier Transformation.
- Fast Fourier Transformation.
- Laplace transformation.
- Z transformation.
- Analog Filters.
- Digital Filters.

In the laboratory part with the Matlab tool, the following exercises will be carried out:

- Signal creation.
- Analysis of signal peaks.
- Comparison of signals.
- Pulse analysis.
- Discrete Fourier transformation.
- Periodic signal power measurement.
- Cutoff filters.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom and computer-lab.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Learning process support through the Moodle online platform. Laboratory teaching.
TEACHING ORGANIZATION	**Activity** | **Semester Workload**

	<table><tr><td>Lectures</td><td>26 hours</td></tr><tr><td>Laboratory Exercise</td><td>26 hours</td></tr><tr><td>Individual Study</td><td>98 hours</td></tr><tr><td>Course Total (25 hours per ECTS)</td><td>150 hours</td></tr></table>
STUDENT EVALUATION	For the successful examination of the course, the student must be successfully examined independently in both parts of the course, theory and laboratory. The evaluation in the theoretical part results from: - 35% will be graded for performance in individual assignments-online tests with multiple choice questions through the course page, - 65% of the final exams of the course with a comparative evaluation of theory elements. The assessment in the laboratory part results from: - active participation during the student's presence and work in the laboratory by 30%, - his/her final exam by 70%. The overall grade of the course is the weighted average of 60% the grade of the theoretical part and 40% of the laboratory.

RECOMMENDED BIBLIOGRAPHY

1. Digital Signal Processing, Antoniou, A. Publications TZIOLA & SONS S.A. (Greek)
2. Digital Signal Analysis, Proakis J, Manolakis D. Ion Publications. (Greek)
3. Digital Signal Processing, A computer-based approach S.K. Mitra McGraw-Hill.
4. Theory and problems in digital signal processing, Monson H. Hayes Tziola Publications. (Greek)
5. Introduction to the theory of signals and systems, Theodoridis S. Berberidis K., Typothito Publications, Athens 2003. (Greek)
6. Introduction to digital signal processing Kogias, G. Synchroni Ekdtotiki 2010. (Greek)
7. Digital signal processing, Basic concepts and applications, Fotopoulos, Spyros Publisher Inspiration S.A. 2010. (Greek)
8. Signal Modulation and Transmission, Kottis P., Tziolas Publications, Thessaloniki 2008. (Greek)

■ CE811 - Time Series Analysis

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE811	**SEMESTER**	H
COURSE TITLE	TIME SERIES ANALYSIS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Skills Development
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With this course, the students will gain knowledge and skills enabling them to: • define notions such as stationarity, • use econometric software packages (e.g. E-views) within the development of time series forecasting models, • evaluate on time series models as well as their results, • evaluate diagnostic test results, • use models for time series forecasting.
General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Decision making.
- Critical thinking practice.

CONTENT OF THE COURSE

This course focuses on time series analysis that constitute one of the important data types used in empirical analysis. The course aims to familiarize students in the Department of Economics with substantial statistical notions as well as the use of appropriate econometric techniques for the development of time series prediction models, by use of econometric software packages (e.g. E-views).
Suggested teaching sections:

- Introduction to time series
- Stochastic time series models and basic notions
- Autoregressive Models (AR)
- Moving Average Models (MA)
- ARMA Models
- ARIMA Models
- Diagnostic tests and model selection criteria
- Forecasting
- ARCH-GARCH models

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Powerpoint presentations, Use of e-class. Communication through face-to-face discussions via e-mails and group discussion on the subject. Use of econometric software (e.g. E-views)
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours
Projects	26 hours
Individual Study	72 hours

	Course Total (25 hours per ECTS) | 150 hours
STUDENT EVALUATION	Written final examination (50%) comprising: 1. Multiple choice questions 2. Assessment on elements of theory 3. Exercise solving Individual laboratory project (50%). <u>Remarks:</u> Both the results on the assessment process and tests will be uploaded on the e-class website.

RECOMMENDED BIBLIOGRAPHY

1. Dimeli S., Modern methods of time series analysis, AUEB Property Management & Development S.A., 2013. (Greek)
2. Asteriou D., Stephen H. Applied Econometrics, Propompos publications, Kimeris K. Thomas, 2018. (Greek)
3. Gujarati D., Basic econometrics, McGraw-Hill Higher Education 2003.

An indicative list of relative scientific journals:

- Econometrica
- Journal of Econometrics
- Econometric Reviews
- Journal of Time Series Analysis
- Journal of Time Series Econometrics
- Quantitative Finance
- Journal of Empirical Finance
- Econometrics Journal
- Journal of Applied Econometrics
- Advances in Econometrics
- Journal of Time Series Econometrics
- Econometrics (MDPI)
- Foundations and Trends in Econometrics
- International Journal of Computational Economics and Econometrics
- Applied Financial Economics

■ CE812 - Microeconomic Analysis

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE812	**SEMESTER**	H
COURSE TITLE	MICROECONOMIC ANALYSIS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Skills Development
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Course aim: The study and understanding of economic units and how they balance in the market. Aim: Microeconomic Analysis aims to acquaint the students of the Department with the functioning of economic units, consumers and businesses and the way they balance in the economic system. Effects on business profits and consumer welfare from different market formats.
General Competencies

Understanding and deepening the operation of businesses and consumer behavior.

CONTENT OF THE COURSE

Introduction-The Economic Problem. Consumer Theory: Consumer Behaviour, Consumer Equilibrium, Income and Substitution Effects-Slutsky's equation, consumer surplus, the demand curve. Production Theory: Production functions, production in the short run, break even cost curves, profit maximization of the firm, returns to scale, economies of scale, production in the long run. Cost theory: nature of cost, short-run and long-run cost curves and their relationships, cost minimization, business expansion path, sweet spot. Market Forms: perfect competition (competitive firm equilibrium, Pareto optimal and welfare analysis), monopoly (concept of Monopoly Power or Market Power, Natural Monopolies, Barriers to Entry, Price Discrimination, Social Welfare Losses due to Monopoly Power). Comparing perfect competition and monopoly in terms of social welfare.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Powerpoint presentations. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	**Semester Workload**
Lectures	52 hours
Individual Study	98 hours
Course Total (25 hours per ECTS)	150 hours

STUDENT EVALUATION	Optional Midterm assessment which receives 30% of the grade. Written final exam including multiple choice questions.

RECOMMENDED BIBLIOGRAPHY

1. Polychronopoulos G., Tsounis. N. (2019) Microeconomic Analysis, Athens: Benou Publications. (Greek)
2. Pseiridou, A., Lianos, Th., 2015. Economic analysis & policy - Microeconomics. [elec. bibl.] Athens: Association of Greek Academic Libraries. (Greek)

3. Varian, H., (2011). Intermediate Micro-Economics, London: Norton.

CE813 - Celestial Mechanics

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE813	**SEMESTER**	H
COURSE TITLE	CELESTIAL MECHANICS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	General Knowledge
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With the completion of the learning process, the students will be able to know: • the relationships that govern the central motion of celestial bodies, • the relationships that govern the elliptical, parabolic and semi-parabolic orbits of celestial bodies, • Newton's Law of Universal Gravitation and Kepler's Laws, • the two-body problem, the N-body problem as well as the limited three-body problem, • the Virial Theorem.

General Competencies
• Search for, analysis and synthesis of data and information, with the use of the necessary technology. • Decision making. • Production of free, creative and inductive thinking.

CONTENT OF THE COURSE

The subject of this course is the physical laws on which the movements of celestial bodies and their orbits are based, examining their kinematics and dynamics.

TEACHING AND LEARNING METHODS - EVALUATION

<table>
<tr><td>TEACHING METHOD</td><td>In the classroom.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>e-Lectures.
Use of e-class.
Communication through face-to-face discussions and e-mails.</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td>
<table>
<tr><th>Activity</th><th>Semester Workload</th></tr>
<tr><td>Lectures</td><td>52 hours</td></tr>
<tr><td>Projects</td><td>42 hours</td></tr>
<tr><td>Individual Study</td><td>56 hours</td></tr>
<tr><td>Course Total
(25 hours per ECTS)</td><td>150 hours</td></tr>
</table>
</td></tr>
<tr><td>STUDENT EVALUATION</td><td>Projects 10%.
Progress-Exam 20%.
Written final examination 70%.</td></tr>
</table>

RECOMMENDED BIBLIOGRAPHY

1. Celestial Mechanics and Astrodynamics: Theory and practice,Pini Gurfil P. Kenneth Seidelmann, Springer Publications.
2. Dynamical Astronomy Courses (Notes), Th.K. Papagiannopoulos, Athens 1997. (Greek)

3. Recent Advances in Celestial and Space Mechanics, Bernard Bonnard, Monique Chyba, Springer Publications.

■ CE814 - General Theory of Relativity

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE814	**SEMESTER**	H
COURSE TITLE	GENERAL THEORY OF RELATIVITY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	General Knowledge
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
With the successful completion of the course, the students will be able to know: • the geometry of curved spaces and make use of tensor algebra (tensors, Christofell symbols), • the energy-momentum tensor and the Maxwell Equations, • the Principle of Equivalence, • Einstein's field equations and their solutions, • the classic experiments associated with the GTR such as the displacement of the perihelion of the planets and the divergence of light rays,

- the physics of gravitational waves.

General Competencies

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Decision making.
- Production of free, creative and inductive thinking.

CONTENT OF THE COURSE

The Geometry of Newtonian Gravitation and the Geometry of curved spaces. The Principle of Equivalence. Einstein's Field Equations. The Cosmological Constant. Black Holes. Solutions of Einstein's equations. The Schwarzschild solution. The Kerr solution. Consequences of GTR: Gravitational Time Dilation and change in the frequency of light. Deflection of light and gravitational time delay (Shapiro Effect). Gravitational Waves. Orbital Precession or Precession of Arcs. Orbital Attenuation. Gravitational Lenses.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Software Mathematica. e-Lectures. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	52 hours
Projects	42 hours
Individual Study	56 hours
Course Total (25 hours per ECTS)	150 hours

STUDENT EVALUATION	Projects 10%. Progress-Exam 20%. Written final examination 70%.

RECOMMENDED BIBLIOGRAPHY

1. General Theory of Relativity, Notes for Students, K. Kokkotas, (Aristotle University of Thessaloniki) 2008. (Greek)
2. General Relativity, Bernard F. Schutz, Travlos Publications & Co. OE. (Greek)
3. Special Relativity, General Relativity, J. Hartle, Tziola Publications, 2011. (Greek)

■ CE815 - Graduate Thesis

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE815	**SEMESTER**	H
COURSE TITLE	GRADUATE THESIS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
	-	12

COURSE TYPE	Skills Development
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	-
COURSE WEBSITE (URL)	-

LEARNING OUTCOMES

Learning Outcomes
The student who has prepared a thesis has delved into a scientific topic of his interest. His/her thesis, which may be analytical, synthetic or applied, reflects his/her theoretical knowledge and methodological skills, as well as the ability to write and comprehensively present a topic based on the commonly accepted principles governing the science of mathematics. The presentation and examination of the thesis evaluates the student's ability to present his/her work to an audience and to provide the necessary answers in order to understand the scientific topic he/she has dealt with.
General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Making decisions.
- Individual work.
- Generation of new research ideas.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

The Thesis can be an important part of the studies and special emphasis should be placed on the choice of the topic, its preparation, writing and presentation.
The Graduate Thesis can be chosen as an elective course in the 8th semester of studies, according to the conditions described in the Graduate Thesis Regulations, and is equivalent to two elective courses (12 ECTS).

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	Face-to-Face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	-
TEACHING ORGANIZATION	**Activity** / **Semester Workload** Individual Study / 300 hours Course Total (25 hours per ECTS) / 300 hours
STUDENT EVALUATION	Graduate Thesis 100%.

RECOMMENDED BIBLIOGRAPHY

The bibliography depends on the subject of the thesis and is in Greek and/or a foreign language.

■ CC11 - Infinitesimal Calculus I

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CC11	**SEMESTER**	A
COURSE TITLE	INFINITESIMAL CALCULUS I		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	5	8

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	-
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
After the successful completion of the course, the students: • will know the basic properties of the natural and real numbers, • will be able to decide on the convergence of series, • will be able to study the continuity and the differentiation of functions of one variable, • will be able to do calculations and draw the graph of a function of one variable.
General Competencies

- Individual work.
- Production of free, creative and inductive thinking, which is based on mathematical processes.

CONTENT OF THE COURSE

Natural and real numbers, the principle of mathematical induction, classical inequalities.
Sequences of real numbers: definition, monotonicity of a sequence, bounded sequence, Cauchy sequence, convergence of a sequence.
The meaning of series, basic properties of series, criteria for convergence.
Functions of a single real variable: limits, continuity, uniform continuity, differentiation and inversibility.
Rules of differentiation, intermediate value theorem, Bolzano theorem, Rolle theorem, monotonicity, extreme values, convexity, asymptotes, graphs of functions.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	65 hours
Projects	45 hours
Individual Study	90 hours
Course Total (25 hours per ECTS)	200 hours

STUDENT EVALUATION	Written final examination 100%.

RECOMMENDED BIBLIOGRAPHY

1. Spivak M, Differential and Integral Calculus, Crete Un. Press, 2010. (Greek)
2. Ntougias S, Calculus vol A, Leader Books, 2007. (Greek)
3. Apostol T, Differential and Integral Calculus, Atlantis Press, 2007. (Greek)
4. Kyventidis T., Differential Calculus of functions of one real variable, Volume 1, Ziti Press, 2001. (Greek)