COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	B.1	SEMESTER	B
COURSE TITLE	MATHEMATICAL ANALYSIS II		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
	4	5
Total	4	5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	GENERAL BACKGROUND
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES (IN ENGLISH)
COURSE WEBSITE (URL)	ECLASS

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

Mathematical Analysis II of the second semester refers to the multivariate analysis (partial derivation and its applications, multiple integrals) and the vector functions in the space (derivative, integration, line integrals, surface integrals, etc.), in order the student to address basic concepts (e.g. gradient, curl, domains, optimization, total differential, etc.). New concepts are introduced for the student, such as surface integrals, Cauchy-Riemann Equations, line integrals etc.
Finally, students will know, through an introductory approach, the calculus of complex series, complex functions and also their integration. Like every mathematical course and lesson, also Mathematical Analysis II, is the promotion of mathematical literacy and the analytical mathematical thinking of the student.

Upon successful completion of this course module students possess advanced knowledge, skills and competences in the subject of Mathematics that enable them to:

- Know and be able to apply the Laplace Operator and Hamilton Operator to Compute gradient, deviation, rotation, etc, for various types of functions.
- Solve basic problems in Vector analysis.
- Know the difference between vector and scalar functions.
- Perform analysis of functions of many variables, compute limits, continuity, derivative, etc.
- Decide whether a given function is harmonic or not.
- Decide whether a vector field is conservative.
- Apply taught methods to compute critical points (maxima and minima) of functions of two or more variables.
- Calculate line integrals of the first and of the second type.
- Calculate surface integrals.
- Able to implement multiple or double integration in applications.
- Learn both the mathematical and the physical dimensions of the concepts associated with Gauss, Green and Stokes theorems.
- Able to handle basic topics: calculating complex functions, complex sequences and integrating complex functions.
- Select the appropriate method for the solution of a given problem. Do this for problems coming from various fields of science and technology.

General Competences

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

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

Analytical and synthetic work using mathematical concepts, and problems solving in key fields of science and engineering.
Autonomous work.
Ability to convert basic physical problems into mathematics-computing problems.
Promote free, creative and inductive thinking.
Adequacy in applying computer software for the practical implementation of mathematical procedures.
Working in an interdisciplinary environment.
Making decisions according to the solution of the Mathematical Problem.

(3) SYLLABUS

The lesson is organized in 26 three-hour lectures.

Section 1 " Vector Calculation and Calculus of Multiple Variable Functions "

• **Lecture 1**: Introduction to Vector Analysis for functions of many variables, Partial Derivatives and Applications.

• **Lecture 2**: Gradient, Directional Derivative, Total Derivative, Examples.

• **Lecture 3**: Maxima and Minima for Functions of two Variables. The Least Squares Line as a Minimization Problem.

• **Lecture 4:** Lagrange multiplies

Section 2 " Double Integrals and Applications "

• **Lecture 5**: Coordinate Systems (polar, cylindrical etc)

• **Lecture 6**: Double Integrals, Exercises-Applications

• **Lecture 7**: Double Integrals in Polar Coordinates (change of variables).

Section 3 "Triple Integrals and Applications"

• **Lecture 8:** Introduction, Triple Integrals in Cylindrical and Spherical Coordinates, Exercises-Examples.

Section 4 "Line integrals of first and second type "

• **Lecture 9:** Introduction to Vector Calculus in 3D Space and to Vector Functions in Space. Properties, Theorems, Applications-Exercises, Examples.

• **Lecture 10:** Line Integrals of the first Type - Applications.

•**Lecture 11**: Line Integrals of the Second Type, Physical Interpretation, Applications.

Section 5 "Fields and Differential Operators"

• **Lecture 12:** Vector Fields, Gradient and Deviation.

• **Lecture 13:** Laplace and Hamilton Operators, Harmonic Functions, Applications.

• **Lecture 14**: Curl, Conservative Fields, Dynamic Functions.

• **Lecture 15:** Exact Differential Forms, Exercises and Examples.

Section 6 "Surface Integrals: Theory and Applications"

• **Lecture 16**: Surface Integrals. Green, Gauss and Stokes Theorems. Mathematical Consideration of them.

• **Lecture 17**: Connections between Mathematics and Physics using the above Theorems.

• **Lecture 18**: Applications in Physics, Exercises.

Section 7 " Calculus of Complex Functions"

• **Lecture 19**: Calculus of Complex Functions (definition, limits and continuity, exponential function).

• **Lecture 20**: Logarithms and trigonometric complex functions.

• **Lecture 21**: Analytical functions, Cauchy-Riemann equations.

• **Lecture 22**: Integration of Complex Functions

• **Lecture 23:** Poles of Complex Functions, Exercises.

• **Lecture 24**: Series of Complex Numbers, Exercises.

• **Lecture 25**: Applications, Examples, Exercises.

Section 8 "Summary and revision"

• **Lecture 26**: Revision of the Basic Course Concepts with Examples and Exercises.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Lectures are offered in class using primarily the blackboard. ICT technologies (slide presentations) are used to emphasize key topics in theory. Problems solution using Modern mathematical tools (Matlab, Mathematica, Wolfram Alpha) corroborate theory and reinforce the learning process.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures	78
Course material study	52
Lectures	52
Exams preparation, Exercises solutions, Bibliographic research	43
Final Exams	3
Course total	*150*

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Students' performance evaluation is based mainly on the final written exam which is in the form of solving problems. The exam is given twice a year in the Greek Language.

(5) ATTACHED BIBLIOGRAPHY

Greek:

- **Advanced Mathematics for Engineers**, Erwin Kreyszig, *Tziolas Publications*.
- **Mathematics II,** Rassias Th., Tsotras, 2017.
- **Mathematics for Engineers,** Georgoudis, Prezerakos,Makriggianis, *Singhroni Ekdotiki* , 2016.
- **Mathematics II**, Masouros, Tsitouras, *Tsotras Publications*.
- **Applied Mathematics**, Alexandropoulos, Vrizidis, *Singhroni Ekdotiki* , 2016.
- **Applied Mathematics**, Hatzarakis, Milonas, *Tziolas Publications*.
- **Infinite Calculus II**, Finney R.L., Weir M.D., Giordano F.R., *University Crete Publications.*

Foreign Language:

- **Thomas Calculus**, 11th edition, Wier, Hass, Jiordano, Pearson AW
- **Methods of Engineering Mathematics**, E. Hang and K.K. Choi, *Prentice Hall, Englewood Cliffs, New Jersey.*
- **Introductory Complex Analysis**, R. Silverman, *Dover.*
- **Advanced Engineering Mathematics**, K.A. Stroud D. Booth, *Palgrave Macmillan*.
- **Advanced Calculus for Applications**, F.B. Hildebrand, *Prentice Hall.*

***Related Scientific Journals**:*

- Journal of Engineering Mathematics
- Topological Methods in Nonlinear Analysis and Applications
- Applicable Analysis and Applications
- Discrete and Continues Dynamical Systems
- Nonlinear Analysis TMA
- Nonlinear Functional Analysis and Applications
- International Journal of Nonlinear Analysis and Applications