COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**10YKO15**	**SEMESTER**	**3**
COURSE TITLE	**MATHEMATICAL METHODS IN PHYSICS** (Complex Analysis)		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	5	7

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	*https://eclass.uoa.gr/courses/PHYS278/*

(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*

The course provides a rigorous, systematic and an in-depth study of the theory of complex functions and its applications in physics problems.

With the completion of the course the student is able to:

- Handle elementary functions of one complex variable, study its fundamental properties, such as analyticity and the types of singular points, and expand a complex function into Taylor or Laurent series.
- Handle mappings by elementary complex functions, and employ the conformal mapping method to solve physics problems (e.g., in fluid dynamics, electrostatics and heat flow).
- Calculate, under parameterization, path integrals in the complex plane, evaluate contour integrals using the residue theorem, and employ the method of residues to evaluate integrals of real functions.
- Evaluate integral transforms (Fourier/inverse Fourier, Laplace/inverse Laplace) of a function, and employ integral transforms to solve differential equations of mathematical physics.
- Employ the methods of stationary phase and steepest descend to evaluate the asymptotic behavior of integrals.

General Competences

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

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

The course aims at the following general competences

Working independently
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Problem solving

(3) SYLLABUS

- Complex numbers, elementary functions of a complex variable, multivalued functions - branches.
- Continuity, derivative of a complex function, analytic functions and Cauchy-Riemann equations, harmonic functions.
- Mapping by elementary functions, conformal mapping, and applications in physics.
- Complex power series, Taylor and Laurent series, classification of singularities, contour integral, Cauchy theorem and residue theorem, evaluation of integrals.
- Fourier and Laplace transforms, applications το partial and ordinary differential equations, stationary phase and steepest descent methods.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face

Distance learning in exceptional situations</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Yes

Electronic communication with the students using ICT (Information and Communications Technology),
eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>110</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>175</td></tr>
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<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek

Oral examination (when appropriate)</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- R. Churchill, J. Brown, Μιγαδικές Συναρτήσεις και Εφαρμογές (ΙΤΕ-Πανεπιστημιακές Εκδόσεις Κρήτης, 2005).
- J. E. Marsden, J. M. Hoffman (μετάφραση: Λ. Παπαλουκάς), Βασική Μιγαδική Ανάλυση (Εκδόσεις Συμμετρία, 1994).
- Σ. Μερκουράκης, Τ. Χατζηαφράτης, Εισαγωγή στη Μιγαδική Ανάλυση (Εκδόσεις Συμμετρία, 2005).