COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**10YKO10**	**SEMESTER**	**1**
COURSE TITLE	**BASIC MATHEMATICAL METHODS**		

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	6

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General 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/PHYS338/*

(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 an introduction to the basic mathematical tools that are necessary for the students of the Physics Department in order to be able to attend without obstacles the Physics courses that follow. Although this introductory course is not strictly rigorous, an extended discussion is followed in order to clarify the connection between the specific mathematical objects and the science of Physics. These mathematical tools are not covered by any other mathematical course.

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

- Handle vectors in 2 and 3 dimensions, perform operations with vectors (addition/ subtraction/ multiplication through interior or exterior product) and understand the necessity for invariance of the output of these operations. Be able to handle and write vectorial quantities properly and use indices for their description. Be able to analyze a vector in a given basis.
- Be able to use polar and spherical coordinates.
- Become acquainted with solid angles and be able to compute them.
- Handle matrices. Realize that matrices could be used either as transformational operators or as tensorial objects that could be transformed. Use the summation convention to describe operations between matrices. Know what the trace and the determinant of a matrix is, as well as the operations of transpose or invertion is.
- Know how to compute the eigenvectors and the eigenvalues of matrices are. Know what diagonalization of a matrix is and how to compute it.
- Perform operations with complex numbers and understand their geometric representation.
- Recognize a Hermitian matrix and understand that their eigenvalues are real.
- Be able to use all the above mathematical tools in physics problems

General Competences

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

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

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. Geometrical representation. De Moivre's theorem. Connection with geometry.
- Vectors and vector operations (addition-subtraction, inner and outer product) with applications to kinematics and geometry. Use of indices and summation convention.
- Matrices. Matrix operations. Matrices as transformations in two or three dimensions. The determinant as volume ratio. Operations on determinants and solution of linear algebraic systems. Inverse matrices. Rotation matrices in two dimensions.
- Eigenvectors and eigenvalues of 2×2 and 3×3 matrices. Matrix diagonalization. Invariance of the trace and determinant.
- Vector spaces as an algebraic structure. Linear independence. Basis. Dimension. Subspaces.
- Metric spaces. Vector orthogonalization.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Parallel live distance learning and recording.</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>40</td></tr>
<tr><td>Exercises</td><td>12</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>98</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</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)
Problems for students to solve at home (optional). The problems are uploaded in eclass.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Notes (in electronic form) adjusted to the material of the course.
- Old school books with appropriate material.

- Related academic journals:

- Various articles on the relation between various aspects of Physics and the mathematical objects taught in the course.