MODULE OUTLINE

1. GENERAL INFORMATION

SCHOOL	SCHOOL OF SCIENCE AND TECHNOLOGY		
PROGRAM COURSE	ADVANCED STUDIES IN PHYSICS		
LEVEL OF STUDY	GRADUATE		
MODULE CODE	PSF51	**YEAR OF STUDY**	1st
MODULE TITLE	MATHEMATICAL METHODS OF PHYSICS		
INDEPENDENT TEACHING ACTIVITIES *in case credits are awarded for separate components/parts of the course, e.g. in lectures, laboratory exercises, etc. If credits are awarded for the entire course, give the weekly teaching hours and the total credits*		**HOURS**	**CREDIS**
Weekly teaching hours: 18-19 h x 3 weeks		560	20 ECTS
COURSE TYPE Compulsory, Optional, Optional mandatory	Compulsory		
PREREQUISITE MODULES:	None		
LANGUAGE OF INSTRUCTION AND EXAMS	GREEK		
THE MODULE IS OFFERED TO ERASMUS STUDENTS	No (due to annual duration of the module)		
MODULE WEBSITE (URL)	https://www.eap.gr/education/postgraduate/annual/advanced-studies-in-physics/topics/#p51 Each module has its own space in the Learning Management System of EAP (http://study.eap.gr), with controlled access (use of code) for students and teaching staff.		

2. LEARNING OUTCOMES

Learning Outcomes
● *The course learning outcomes, specific knowledge, skills and competences of an appropriate (certain) level, which students will acquire upon successful completion of the course, are described in detail. It is necessary to consult:*
Students who successfully complete this module unit will be able to analyze and model natural processes and phenomena with advanced mathematical methods and produce analytical results in several cases. More specifically, students will be able to: • use basic elements of complex analysis to calculate integrals and infinite series • solve second-order ordinary differential equations, which often appear in physics, using special functions whose properties are also thoroughly studied • apply integral transformations to solve physics problems

- use special functions, the method of separation of variables and appropriate coordinate systems to solve partial differential equations that arise in boundary and initial condition problems
- solve physics problems using Green's functions
- formulate physical problems as transformation problems and produce analytical solutions
- know probability theory, calculate the probability distributions of random variables and their functions, and analyze experimental data.

General Competences

Taking into consideration the general competences that students/graduates must acquire (as those are described in the Diploma Supplement and are mentioned below), at which of the following does the course attendance aim?

Search for, analysis and synthesis of data and information by the use of appropriate technologies,	*Project planning and management*
Adapting to new situations	*Respect for diversity and multiculturalism*
Decision-making	*Environmental awareness*
Individual/Independent work	*Social, professional and ethical responsibility and sensitivity to gender issues*
Group/Team work	*Critical thinking*
Working in an international environment	*Development of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Introduction of innovative research	*(Other…….citizenship, spiritual freedom, social awareness, altruism etc.) …….*

Adapting to new situations
Decision-making
Individual/Independent work
Project planning and management
Critical thinking
Development of free, creative and inductive thinking

3. MODULE CONTENT

Physics as a science acquired substantially changed as it began to use Mathematics already a few centuries ago as its main tool. In modern times, this relationship has strengthened so much that all serious attempt to solve physical problems cannot be understood without the use of Mathematics, but it has also evolved to the point that it acquired a two-way character. According to these considerations, the purpose of module is for the student to acquire the necessary basic knowledge in various areas of Mathematics and to learn how to apply the relevant methods to solve physical problems.

In detail, the content of the module is:

- Differential equations: classification into linear and non-linear, as well as ordinary and partial differential equations. Methods of solving linear differential equations, with constant and non-coefficients (emphasis on second order). Smooth and non-smooth points, applications to physical systems.
- Complex analysis and applications in the calculation of integrals and infinite sums.

- Special functions and orthogonal polynomials. Expansion in eigenfunctions. Laplace, diffusion, Helmholtz, Poisson equations
- Green's functions: Construction of Green's functions for the Helmholtz, Poisson, Laplace equations and for the wave equation.
- Problems in Cartesian, spherical and cylindrical coordinates with homogeneous and inhomogeneous boundary conditions. Expansion in orthogonal polynomials.
- Boundary and initial condition problems.
- Calculus of changes and physical applications.
- Probability theory and experimental data analysis. Applications to physics problems.

The key subjects of the module are:

• Mathematical Methods of Physics
• Statistical Methods of Experimental Data Analysis

4. TEACHING METHODS--ASSESSMENT

MODES OF DELIVERY *Face-to-face, in-class lecturing, distance teaching and distance learning etc.*	Distance learning by conducting six Group Counseling Meetings on weekends during the academic year.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY *Use of ICT in teaching, Laboratory Education, Communication with students*	In the meeting and/or in the homework's the following are used: - remote meeting tools (cisco Webex, zoom), - presentation software (powerpoint type), - graphic tablets - digitizers In addition, students use office automation tools, web browsers as well as e-readers for digital books.
MODULE DESIGN *Description of teaching techniques, practices and methods: Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, Internship, Art Workshop, Interactive teaching, Educational visits, projects, Essay writing, Artistic creativity, etc* *The study hours for each learning activity as well as the hours of selfdirected study are given*	

Activity	***Annual Workload***
6 meetings (x 4 hours)	24
Assignments (6 assignments x 20 hours)	120
Exams	3
Individual study	400 - 426
Total module workload (hours)	**547 – 573**

following the principles of the ECTS.	
STUDENT PERFORMANCE EVALUATION/ASSESSMENT METHODS *Detailed description of the evaluation procedures.* *Language of evaluation, assessment methods, formative or summative (conclusive), multiple choice tests, short- answer questions, open-ended questions, problem solving, written work, essay/report, oral exam, presentation, laboratory work, other……etc.* *Specifically defined evaluation criteria are stated, as well as if and where they are accessible by the students*	The exam language is Greek. Written assignments during the academic year, the average of the grades of which participates in the formation of the final grade of the module by 30% if there is a pass in the final or repeat exams. Final written exams, the grade of which participates in forming the final grade of the module by 70%. All criteria are posted, both for each written assignment (in the study) as well as for the general regulation in: https://www.eap.gr/education/study-regulations/

(6) SUGGESTED BIBLIOGRAPHY

- *Suggested bibliography:*

HOU Publications:
Volume A': Mathematical Methods of Physics - Study Manual, HOU, Patras 2004
Volume B': Statistical Methods of Experimental Data Analysis, HOU, Patras 2004
Accompanying Text for the module PSF51: Tsironis, Differential Equations II, HOU, Patras 2005.

Books offered by HOU: Arfken, Weber and Harris, Mathematical Methods for Physicists, 7th ed., Academic Press 2012

Alternative teaching material (Created by K. Sfetsos, Offer through HOU Platform), Webcast.
In the server https://apothesis.eap.gr operates a repository with digital collections of alternative teaching materials.