

Module Outline

1. GENERAL

SCHOOL	Science and Technology		
PROGRAMME	Studies in Natural Sciences		
LEVEL OF STUDIES	Undergraduate		
MODULE CODE	FYE-10	YEAR	1
MODULE TITLE	Mathematics I		
INDEPENDENT TEACHING ACTIVITIES <i>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</i>		HOURS	CREDITS
Weekly workload: 17-18 hours x 32 weeks		560	20 ECTS
MODULE TYPE <i>Compulsory/Elective/ Mandatory Optional</i>	Mandatory		
MODULE DESCRIPTION <i>general background, special background, specialised, general knowledge, skills development</i>	General Background		
PREREQUISITE MODULES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE MODULE OFFERED TO ERASMUS STUDENTS	No		
MODULE WEBSITE (URL)	The Module has its own space in the digital learning environment of HOU (https://study.eap.gr/login/index.php) with controlled access (using a code) for students and Teaching Staff. https://www.eap.gr/el/programmata-spoudwn/177-spoudes-stis-fysikes-epistimes/diathrwsis/404-580a04b160b571f1bd5efe46cd520f0d		

2. LEARNING OUTCOMES

Learning outcomes

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

LEARNING OUTCOMES

Knowledge:

Successful completion of the Module FYE10 "General Mathematics I" provides the student with the opportunity to develop the following skills and to be able to:

- apply convergence criteria for numerical sequences and series;
- utilize fundamental theorems (Darboux, Rolle, Cauchy, Mean Value Theorem, Extreme Value Theorem) in problem-solving, such as describing the behavior of real functions of one real variable, optimization, and the existence and approximation of solutions to equations, among others;
- use polynomial approximations (Taylor and Maclaurin expansions) for algebraic and transcendental functions, as well as the conditions (errors and intervals) under which they are valid;

- utilize Definite, Indefinite, and Improper Integrals within the context of specific applications, such as finding antiderivatives, calculating the area of plane regions, surface areas, and volumes of solids of revolution, etc.;
- approximate periodic functions with the aid of Fourier Series;
- utilize the theorems of Continuity, Differentiability, Mean Value, Extreme Value, and Inverse Function Existence;
- apply the Implicit Function Theorem to solve problems such as the existence and description of the behavior of real functions of multiple real variables, optimization, and the approximation of values of a function of two variables using Taylor expansions;
- use multiple integration methods within the context of specific applications, such as calculating the area of plane regions, surface areas and volumes of solids, moments of inertia, centers of mass, etc.;
- solve geometric problems with the help of vectors;
- describe curves and surfaces in three dimensions using vector-valued functions;
- utilize Green's, Gauss's, Stokes', and Helmholtz's Theorems to describe vector fields.

Skills:

Upon successful completion of the Module, students are expected to:

- Apply convergence criteria related to numerical sequences and series.
- Use the fundamental theorems of differential calculus (such as the Darboux, Rolle, Cauchy, Mean Value, and Extreme Value theorems) to solve problems.
- Describe the behavior of real functions of one variable and solve problems involving optimization, as well as the existence and approximation of equation solutions.
- Employ polynomial approximations via Taylor and Maclaurin expansions for algebraic and transcendental functions, identifying the conditions and errors under which they remain valid.
- Utilize definite, indefinite, and improper integrals in applications such as finding antiderivatives and calculating the areas of plane regions, surface areas, and volumes of solids of revolution.
- Approximate periodic functions using Fourier series.
- Solve problems involving functions of multiple variables using theorems of continuity, differentiability, mean value, inverse function existence, and the implicit function theorem.
- Apply multiple integration methods to calculate areas, volumes, moments of inertia, and centers of mass.
- Solve geometric problems with the aid of vectors.
- Describe curves and surfaces in three dimensions using vector-valued functions.
- Utilize the Green, Gauss, Stokes, and Helmholtz theorems for the description of vector fields.
- Organize and apply the acquired knowledge to solve specific problems.
- Understand and summarize scientific papers within the corresponding mathematical fields.
- Develop an intuitive and insightful perspective on mathematical concepts and methods.

Competences:

Upon successful completion of the Module, students are expected to:

- Search, analyze, and synthesize data and information, utilizing the necessary technologies.
- Adapt effectively to new situations.
- Possess the ability to make informed decisions.
- Work autonomously with self-reliance.
- Function and perform effectively within a team environment.
- Work in a multidisciplinary environment.
- Demonstrate respect for diversity and multiculturalism.
- Demonstrate respect for the natural environment.
- Show social, professional, and ethical responsibility, maintaining integrity.
- Exercise criticism and self-criticism for continuous improvement.
- Promote free, creative, and inductive thinking.
- Develop an intuitive and insightful perspective of mathematical concepts and methods.

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 Module aim?

Search for, analysis and synthesis of data and Project planning and management

<i>information, with the use of the necessary technology</i> <i>Adapting to new situations</i> <i>Decision-making</i> <i>Working independently</i> <i>Team work</i> <i>Working in an international environment</i> <i>Working in an interdisciplinary environment</i> <i>Production of new research ideas</i>	<i>Respect for difference and multiculturalism</i> <i>Respect for the natural environment</i> <i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i> <i>Criticism and self-criticism</i> <i>Production of free, creative and inductive thinking</i>
The general skills that the students will acquire are: Upon successful completion of the Module FYE10, the student will be able to: • Organize and utilize the acquired knowledge to solve specific problems • Understand and recognize the application of Mathematics in the natural sciences.	

3. SYLLABUS

Purpose of Module

Upon successful completion of this Module, students are expected to:

- Become familiar with and understand the core mathematical concepts that will allow them to study elements of the Natural Sciences, such as Physics, Chemistry, Biology, and Geology.
- Become fully acquainted with the fundamental concepts of Differential and Integral Calculus, as well as the techniques and methods of mathematical analysis in one variable.
- Extend their knowledge to multivariable calculus by learning and applying the fundamental theorems of vector analysis.
- Acquire skills in using mathematical concepts to describe and address problems related to the natural environment.
- Develop the ability to organize the knowledge they acquire to solve specific scientific problems.
- Be able to understand and summarize scientific papers within the corresponding mathematical fields.

Subjects covered

- Introductory Mathematics
- Calculus of one variable
- Multivariable Calculus

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	- Distance teaching and learning with three (6) Group Counseling Meetings (GCMs) of 4-hour duration during the academic semester on weekends. In addition, at least six (6) supportive Group Counseling Meetings are held, with a duration of at least 2 hours each. - Personal communication and feedback (advisory role of Adjunct Faculty).
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	<u>During GCMs and teaching the following are used:</u> - Remote meetings tools (webex, Teams), - Presentation software (PowerPoint, educational video - animations etc.), - Specialized software/databases for the subjects under study (NCBI PubMed, NCBI Blast, EndNote etc.). In addition, students use office automation tools, web browsers and e-reader for digital books. <u>Communication with the students is supported by:</u> - The digital platform of HOU (https://study.eap.gr/login/index.php) (course information, educational material posts, announcements,

	messages, examination results, user groups, discussion forums etc.). - e-mail																
TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i> <i>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.</i> <i>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</i>	<table border="1"> <thead> <tr> <th>Activity</th><th>Year Workload</th></tr> </thead> <tbody> <tr> <td>6 GCMs (x 4 hours)</td><td>24</td></tr> <tr> <td>6 Written Assignments (x 12 hours)</td><td>72</td></tr> <tr> <td>Individual Study time (13,5-14 hours x 32 weeks)</td><td>441</td></tr> <tr> <td>6 supportive GCMs (x 2 hours)</td><td>12</td></tr> <tr> <td>Self-evaluation activities</td><td>6</td></tr> <tr> <td>Final examination</td><td>5</td></tr> <tr> <td>Total Workload</td><td>560</td></tr> </tbody> </table>	Activity	Year Workload	6 GCMs (x 4 hours)	24	6 Written Assignments (x 12 hours)	72	Individual Study time (13,5-14 hours x 32 weeks)	441	6 supportive GCMs (x 2 hours)	12	Self-evaluation activities	6	Final examination	5	Total Workload	560
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STUDENT PERFORMANCE EVALUATION <i>Description of the evaluation procedure</i> <i>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</i> <i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i>	Students' evaluation – Grade assessment of a Module: • Written Assignments (WA): Contribute 30% to the final grade (provided that the student achieves a passing grade in the final exams). • Final Exams (FE): Contribute 70% (35% for Part A and 35% for Part B). • Optional Midterm Exam: An opportunity to participate after the completion of Part A of the course material. The Final Grade for the Module, on a scale of 10, is calculated as follows: $\text{Final Grade} = (\text{WA} \times 0.3) + (\text{FE} \times 0.7)$ Language of evaluation: Greek																

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- **Publications of Hellenic Open University:**
 - Volume A': Calculus of one variable (G. Dassios).
 - Volume B': Calculus of several variables (G. Dassios).
 - Volume FYE 14/A': Introductory Mathematics Concepts (M. Hadjinicolaou)
 - Hass, Heil, Weir, Thomas Calculus, "Απειροστικός Λογισμός", Crete University Press.
- **Related academic journals:** Journal of Acoustical Society, Mathematics, ZAMP, JAMP, Journal of Mathematical Biology, JACS
- **Alternative material:** Hypertext and Webcasts via the platform

