COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
DEPARTMENT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	ISCED level 6 – Bachelor's or equivalent level		
COURSE CODE	YN204	**SEMESTER**	2nd Semester
COURSE TITLE	Mathematics II		

TEACHING ACTIVITIES *If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
	4	5
Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.		

COURSE TYPE *Background, General Knowledge, Scientific Area, Skill Development*	General Background
PREREQUISITES:	
TEACHING & EXAMINATION LANGUAGE:	Greek
COURSE OFFERED TO ERASMUS STUDENTS:	NO
COURSE URL:	https://eclass2.emt.duth.gr/courses/CHEM-N1102/

(2) LEARNING OUTCOMES

Learning Outcomes
Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.

In the first part of the course, students aim to extend their fundamental knowledge of Differential and Integral Calculus to real functions of *n* independent variables and apply these concepts to various scientific fields in the Natural Sciences (Chemistry, Physics, etc.). The second part of the course introduces students to the basic concepts of Probability Theory, random variables and distributions, as well as the fundamental principles of Statistics and Quantitative Analysis. Students are expected to be able to use methods for data description and exploratory data analysis, analyze correlations and agreements, and model relationships using regression methods.

Upon successful completion of this course, students will be able to:

- Understand and apply the fundamental concepts of vectors, operations in the n-dimensional Euclidean space, and geometric interpretations such as projections and inner, outer, and mixed products.
- Describe and analyze real functions of several variables, including limits, continuity, and graphical representation in multiple dimensions.
- Compute and interpret partial derivatives of multivariable functions, understand their geometric meaning (gradient, tangent plane), and extend differentiation to higher-order partial derivatives.
- Identify and determine extrema of functions of several variables and generalize optimization techniques.

- Apply integral calculus to evaluate double integrals over rectangular and general regions and interpret their applications in physical and chemical contexts.
- Understand the basic concepts of Probability Theory, including counting principles and combinatorics (permutations, arrangements, combinations).
- Apply the fundamental theorems of probability, including conditional probability, Bayes' theorem, and the laws of multiplication, joint, and marginal probabilities.
- Recognize and use discrete and continuous probability distributions, including Bernoulli, Binomial, Geometric, Hypergeometric, Poisson, Uniform, Normal, and Exponential distributions.
- Use graphical and numerical methods for data summarization and exploratory data analysis (bar charts, pie charts, histograms, boxplots).
- Apply descriptive statistics to compute and interpret measures of central tendency, relative position, variability, skewness, and kurtosis for grouped and ungrouped data.
- Perform correlation analysis using parametric and non-parametric correlation coefficients, and assess agreement between qualitative (Cohen's/Fleiss' Kappa) and quantitative variables (Lin's Concordance Coefficient, Kendall's W, Bland–Altman method).
- Construct and evaluate linear regression models using the least squares method and assess goodness of fit.
- Develop analytical and quantitative reasoning skills for solving problems in scientific disciplines through the use of calculus, probability, and statistics.

General Skills

Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information,	*Project design and management*
ICT Use	*Equity and Inclusion*
Adaptation to new situations	*Respect for the natural environment*
Decision making	*Sustainability*
Autonomous work	*Demonstration of social, professional and moral responsibility and*
Teamwork	*sensitivity to gender issues*
Working in an international environment	*Critical thinking*
Working in an interdisciplinary environment	*Promoting free, creative and inductive reasoning*
Production of new research ideas	

(3) COURSE CONTENT

Week 1: The Euclidean Space $\mathbb{R}^n$: Points in n-dimensional space, vectors, vector operations, projection, inner, outer, and mixed products.

Week 2: Real Functions of Several Variables: Graphical representation of multivariable functions, limits and iterated limits, continuity of functions of n variables.

Week 3: Partial Derivatives of Multivariable Functions: Properties of derivatives, geometric interpretation of partial derivatives, gradient and tangent plane, higher-order partial derivatives (simple and mixed).

Week 4: Optimization: Finding extrema of multivariable functions and generalizations.

Week 5: Integral Calculus: Double integrals, double integrals over rectangles, and double integrals over general regions.

Week 6: Introduction to Probability: Basic concepts of probability, counting principles, combinatorics (permutations, arrangements, combinations).

Week 7: Fundamental Theorems of Probability: Conditional probability, Bayes' theorem, multiplication law, joint and marginal probabilities.

Week 8: Probability Distributions: Random variables (discrete/continuous), special discrete distributions (Bernoulli, Binomial, Geometric, Hypergeometric, Poisson).

Week 9: Continuous Distributions: Uniform, Normal, and Exponential distributions.

Week 10: Introduction to Statistics: Graphical methods for data summarization (bar chart, pie chart, histogram, boxplot), exploratory methods. Descriptive Statistics: Numerical data summarization methods (grouped and ungrouped), measures of central tendency, relative position, variability, distribution, skewness, and kurtosis.

Week 11: Correlation Analysis: Parametric and non-parametric correlation coefficients; agreement analysis for qualitative variables (Cohen's Kappa, Fleiss' Kappa) and quantitative variables (Lin's Concordance Coefficient, Kendall's W, Bland–Altman method).

Week 12: Regression Analysis: Linear regression model, least squares method, and goodness-of-fit assessment.

Week 13: Applications to Chemistry and Life Sciences.

(4) LEARNING & TEACHING METHODS - EVALUATION

<table>
<tr><td>TEACHING METHOD
Face to face, Distance learning, etc.</td><td>Face to face</td></tr>
<tr><td>USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT)
Use of ICT in Teaching, in Laboratory Education, in Communication with students</td><td>Use of ICT in Teaching
Use of ICT in Communication with students</td></tr>
<tr><td>TEACHING ORGANIZATION
The ways and methods of teaching are described in detail.
Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.

The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</td><td><table><tr><th>Activity</th><th>Workload/semester</th></tr><tr><td>Lectures</td><td>52</td></tr><tr><td>Bibliographic research & analysis</td><td>98</td></tr><tr><td>Total</td><td>150</td></tr></table></td></tr>
<tr><td>STUDENT EVALUATION
Description of the evaluation process

Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</td><td>Student evaluation languages
Greek
Method (Formative or Concluding)
Summative
Student evaluation methods
Written Exam with Problem Solving
Rate
100</td></tr>
</table>

Please indicate all relevant information about the course assessment and how students are informed	

(5) SUGGESTED BIBLIOGRAPHY

- Μαθηματικά ΙΙ, Edwards C. Henry, Penney E. David (Επιμ. Ματζάκος Ν.). ΜΑΡΙΑ ΠΑΡΙΚΟΥ & ΣΙΑ ΕΠΕ. ISBN: 9789605081591.
- Μαθηματική ανάλυση, Τόμος ΙΙ, Ξένος Θανάσης Π. Ζήτη Πελαγία & Σια Ι.Κ.Ε. ISBN: 9604319647.
- Εφαρμοσμένη Στατιστική και Πιθανότητες για Μηχανικούς, 6η Έκδοση, Montgomery Douglas-Runger C. George. ΕΚΔΟΣΕΙΣ Α. ΤΖΙΟΛΑ & ΥΙΟΙ Α.Ε. ISBN: 9789604187089.
- Δ. Γεωργίου (2009). Πιθανότητες και Στατιστική. Εκδόσεις Κλειδάριθμος.