
COURSE: PRINCIPLES OF MATHEMATICS

ACADEMIC YEAR: 2019-2020

TYPE OF EDUCATIONAL ACTIVITY: Basic

TEACHER: Prof. Angelo Sonnino

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mobile (optional):

Language: **Italian**

ECTS: **10** (64 lessons and
24 tutorials/practice)n. of hours: (lessons e
tutorials/practice)Campus: **Potenza**
Dept./School: **Dipartimento di
Scienze**
Program: **BIOTECHNOLOGIES**Semester: **I**
(expected dates: from
01/10/2019 to
20/01/2020)

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

- **Knowledge and understanding.** Knowledge of some mathematical tools often used in Biology, Chemistry and Physics: elements of linear algebra, differential and integral calculus, probability and statistics.
 - **Applying knowledge and understanding.** Using such mathematical tools and applying them for solving problems in Biology, Chemistry and Physics.
 - **Making judgements.** Choosing suitable mathematical methods for describing phenomena and solving problems.
 - **Communication skills.** Using a proper mathematical language to express the knowledge in oral and written form. Justify the choice of the method for solving theoretical and application problems.
 - **Learning skills.** Learning the contents of the course and relating them to other topics in the Program of Studies. Using the suggested books for exercises, insights and comparisons.
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PRE-REQUIREMENTSBasic mathematical notions at the high school level.

SYLLABUS**Theory of sets, numerical sets and data representation (8h)**

Intuitive set theory: sets and subsets, cardinality, operation between sets, Cartesian product and strings. Numerical sets (N, Z, Q, R) and operations. Geometric representation of numbers: real line and Cartesian plane. Absolute value and distance. Scientific notation and approximations. Functions, injective, surjective and bijective functions, composition and graphics. Equations and inequalities. Cartesian diagrams and histograms. Examples and applications.

Analytic geometry and linear algebra (20h)

Vector calculus: vectors in R^n , linear combinations, scalar product and inner product. Linear independence. Angles and trigonometry, polar and spherical coordinates, orthogonal projections. Matrix calculus: $m \times n$ matrices, matrix addition and scalar multiplication, matrix multiplication, inversion of matrices, determinant and rank. Parametric and Cartesian equations of planes and straight lines in R^2 and R^3 . Systems of linear equations: Gaussian elimination method and solutions. Linear maps. Examples and applications.

Functions and models (16h)

Linear and non-linear models. Elementary functions and their properties. Algebraic functions: linear functions, quadratic functions, polynomial functions, power functions, rational functions. Transcendental functions: exponential functions, logistic functions, logarithmic functions, trigonometric functions. Examples and applications.

Differential and integral calculus (28h)

Limits of functions and sequences. Continuity and discontinuities. Discrete dynamic systems: first order difference equations with constant coefficients. Differential calculus: derivation and rate of variation, graphical interpretation, differential, derivative calculus, maxima and minima, qualitative study of functions, de l'Hôpital's rule, Taylor's formula. Integral Calculus for functions of one real variable: defined integral and Graphical Interpretation, Indefinite Integral, Integral Properties, immediate integral calculation, integration by parts, integration by substitution, improper integral, mean of a function. Examples and applications.

Probability and statistics (16h)

Combinatorics: permutations, combinations, binomial coefficients and binomial formula. Discrete probability: events, probability distributions, relative frequencies, probability axioms, independent events, conditional probability, binomial distribution. Statistics: means, median, mode, variance, method of least squares. Continuous probability: random variables, mean and variance of discrete random variables, Poisson distribution, continuous random variables, distribution function, uniform distribution, exponential distribution, normal distribution, samples and population. Examples and Applications.

TEACHING METHODS

The course consists of 64 hours of lessons and 24 hours of exercises tutorials.

Furthermore, some optional hours will be devoted to intermediate written test and for exam simulations. The lectures will deal with theoretical aspects of the subject, exercises resolution and some applications.

EVALUATION METHODS

Written test and oral examination.

The exam is divided into two parts.

- A written test containing theoretical and application exercises on all the topics covered in the course; the test is intended to evaluate the knowledge and understanding of the topics and is selective (the student who does not show sufficient knowledge of the subjects is not admitted to the oral examination). To pass the test one must obtain at least 16 points out of 30. The expected time for the test is 2 hours. During the test the use of a pocket or scientific calculator is allowed, but the use of graphic calculator, books, notes, notebook, tablet or smartphone is forbidden.
- An oral examination (to be taken during the same exam session of the written test) which will evaluate the ability to link and compare different topics of the course and will consist in the discussion of the written test, some theoretical questions and eventually short exercises. After this examination, the student will receive a final grade: in order to pass the exam this grade should be at least 18 out of 30; otherwise, one should repeat both the written test and the oral examination.

Students who attend the lectures may take optional intermediate written tests with theoretical and practical exercises on specific parts of the program.

TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL**Textbook:**

- M. Abate. *Matematica e statistica, le basi per le scienze della vita*. McGraw-Hill, 2009.

Further readings:

- D. Benedetto, M. degli Esposti, C. Maffei. *Matematica per le scienze della vita*. Ambrosiana, 2012.
- N. Fusco, P. Marcellini, C. Sbordone. *Elementi di analisi matematica uno*. Liguori Editore, 2002.
- N. Fusco, P. Marcellini, C. Sbordone. *Elementi di analisi matematica due*. Liguori Editore, 2001.
- P. Marcellini, C. Sbordone. *Esercitazioni di matematica 1° volume, parti I e II*. Liguori Editore, 1995.
- G. Strang. *Algebra Lineare*. Apogeo, 2008.

INTERACTION WITH STUDENTS

At the beginning of the course goals, program and evaluation method will be described.

At the end of the discussions of each topic the teacher provides the related teaching material in the web page of the course.

*Office hours: from Wednesdays and Fridays from 10:30 to 13:00, Thursdays from 15:30 to 18:00, office n. 3D218 of DiMIE - Department of Mathematics, Computer Science and Economics, **by appointment**.*

EXAMINATION SESSIONS (FORECAST)¹

12/02/2020, 04/03/2020, 25/06/2020, 08/07/2020, 02/09/2020, 01/10/2020, 16/12/2020.

SEMINARS BY EXTERNAL EXPERTS YES NO

FURTHER INFORMATION

1. Subject to possible changes: check the web site of the Teacher or the Department/School for updates.