UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2023/2024
BACHELOR'S DEGREE (BSC)	BIOMEDICAL ENGINEERING
INTEGRATED COURSE	MATHEMATICAL ANALYSIS - INTEGRATED COURSE
CODE	19109
MODULES	Yes
NUMBER OF MODULES	2
SCIENTIFIC SECTOR(S)	MAT/05
HEAD PROFESSOR(S)	SCIACCA MICHELE Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	SCIACCA MICHELE Professore Associato Univ. di PALERMO MANCINI MANUEL Professore a contratto Univ. di PALERMO
CREDITS	12
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	Annual
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**MANCINI MANUEL** Monday 11:00 12:00 Studio 108, 1° Piano, Dipartimento di Matematica e Informatica, Via Archirafi, 34 - 90123 Palermo Wednesday 11:00 12:00 Studio 2090, 2° Piano, Dipartimento di Ingegneria, Edificio 8, ex Dipartimento di Metodi e Modelli Matematici, Viale delle Scienze - 90128 Palermo **SCIACCA MICHELE** Monday 08:30 11:00 sede del corso di Studi in Viticoltura ed Enologia Wednesday 12:00 14:00 Studio del docente - Edificio 8 - Dip. Ingegneria - Ex Dip. Metodi e Modelli Matematici (primo piano)

DOCENTE: Prof. MICHELE SCIACCA

PREREQUISITES	1. Operations on integers, rational numbers, real numbers and their properties. 2. Operations and decompositions of polynomials. 3. Algebraic, rational and irrational equations and inequalities. 4. The powers, the logarithms and their main properties. 5. Basic notions of analytical geometry. Cartesian coordinates in the plane, equation of the line and conics (circumference, parabola, ellipse) in canonical form. 6. Basic knowledge of trigonometry. The cosine, the sine, the tangent. Main trigonometric formulas. Resolution of trigonometric equations and inequalities.
LEARNING OUTCOMES	1. Knowledge The Student will have to know the basic concepts of Mathematical Analysis such as: various numerical sets, limits, derivatives (also of functions of several variables), integrals (also of functions of several variables), graphs of functions, differential equations. 2. Ability to apply knowledge and understanding The Student will have to acquire the skills of critical synthesis that will put him in a position to make use of the theoretical and practical knowledge acquired to face the study of problems, even complex, inherent: the theory of optimization of real functions, even more variables; differential equations and the study of some dynamic systems; the integral calculation and the calculation of areas of two-dimensional domains or volumes of three-dimensional domains. 3. Autonomy of judgment The Student must be able to independently identify the mathematical aspect of the problems he will encounter in the training path or in the profession. Moreover, it will have to be able to discern which mathematical tools to use, identifying, among the possible alternatives, the most suitable solutions to face the problem in question. 4. Communication skills The Student must be able to correctly express the mathematical concepts learned during the course. These skills must be acquired both verbally and in writing, respecting logical and symbolic rigor. 5. Learning skills The Student will have to acquire a study methodology that allows him to deepen, even in an autonomous way, through an adequate use of the results known in literature and therefore also of a more careful bibliographic survey, the mathematical issues inherent in the problems he will face.
ASSESSMENT METHODS	The final assessment consists of a written test and an oral test. The written test will require the resolution of questions concerning the various topics covered during the course (function graphs, calculation of limits and derivatives, study of functions of onereal variable, numerical series, complex numbers, partial derivatives , optimization of real functions of two real variables, calculation of integrals of functions of one or more variables, resolution of differential equations, study of the convergence of sequences and series of functions). Here we will evaluate both the computational skills achieved by the Student and the level of learning of the theoretical results that justify the proposed resolutions. In particular, some questions may be of a purely theoretical nature. The written test is evaluated in thiertieths and it is furnished after a discussion on the job produced by the student. The oral examination (which can be accessed after passing the written one) will have the purpose to deepen the verification of the level of maturation of the knowledge of the subject, as well as of the ability to display the theoretical contents (definitions, enunciation and demonstration of the results proposed during the course). The oral examination is due whenever the written has been evaluated more than 25/30. If the witten has been evaluated between 18/30 and 25/30 the oral examination can be avoided. The final assessment will take into account the outcome of both the written and oral tests. It will be expressed in thirtieths and will be formulated on the basis of the following scheme: 29/30 - 30/30: Excellent, broad and in-depth knowledge of the required topics that are applied with excellent mastery, in full autonomy and with methodological rigor. Communication skills and language mastery of excellent level. The praise will be given to particularly deserving Students who, in reference to the aforementioned criteria, will show excellent qualities. 26/30 - 28/30 Good knowledge of the required arguments that are applied with good mastery, in good, but not total, autonomy and with good methodological rigor. Communication skills and language mastery of good level. 22/30 - 25/30 Discreet knowledge of the required arguments that are applied with discrete mastery, with discrete autonomy and with a discrete methodological rigor. Communication skills and language mastery of discrete level. 18-30 - 21/30 Basic knowledge of the required topics that are applied with limited ability and with sufficient autonomy and methodological rigor. Communication skills and language mastery of sufficient level.
TEACHING METHODS	

	The course is annual, split in two modules, and takes place in the two didactic periods of the first year: the first module in the first semester, the second module in the second semester. Teaching will be provided through lessons and exercises.
	At the end of each teaching module a written test will be scheduled in progress, evaluated according to the detailed criteria in the "Assessment methods" section. The passing of these tests in itinere can exempt the Student, completely or even partially, from the obligation to have to take the final written test.

MODULE
MATHEMATICAL ANALYSIS - MODULE 2

Prof. MANUEL MANCINI

SUGGESTED BIBLIOGRAPHY

- M. Bertsch, R. Dal Passo, L. Giacomelli, Analisi Matematica, McGraw-Hill Education, 2014 (ISBN: 8838668949)
- M. Bramanti, C.D. Pagani, S. Salsa - Analisi matematica 2 Ed. Zanichelli, Bologna, 2009 (ISBN: 9788808122810)
- N. Fusco, P. Marcellini, C. Sbordone, Lezioni di Analisi Matematica due, Zanichelli 2020 (ISBN: 9788808520203)
- Claudio Canuto, Anita Tabacco, Mathematical Analysis II, Springer 2015 (ISBN 978-3-319-12756-9)
- M. Bramanti - Esercitazioni di Analisi Matematica 2 Ed. Esculapio, Bologna, 2012 (ISBN: 8874884826)
- P. Marcellini, C.Sbordone - Esercitazioni di Matematica 2 - Zanichelli 2017 Parte prima e parte seconda (ISBN: 978-8808220707; ISBN: 978-8808191458)

AMBIT	50292-Matematica, informatica e statistica
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54

EDUCATIONAL OBJECTIVES OF THE MODULE

We introduce the fundamental elements of differential and integral calculus for real functions of two real variables; moreover some classes of differential equations are proposed and the sequences and the series of functions are treated, with particular reference to the power series and the Fourier series.

SYLLABUS

Hrs	Frontal teaching
2	Overview of topology in n-dimensional Euclidean spaces.
2	The real functions of two real variables: generality, the graph, level sets, limits and a selection of the main theorems.
2	The continuity of the functions of two variables. A selection of the main theorems and most relevant properties.
4	Partial derivatives, the gradient, higher order derivatives, directional derivatives, differentiability. The tangent plane to a regular Cartesian surface.
4	Critical points of functions of two variables and their classification: necessary and sufficient conditions. The Taylor polynomial of the second order of a regular function of two variables. Constrained optimization.
4	Riemann double integrals: definition, properties and applications. Integration methods. Hints on triple integrals.
4	Ordinary differential equations: introduction, some concrete models. The Cauchy problem. Some resolution techniques.
2	Sequences of functions.
4	Series of functions. Power series. Taylor's series. Fourier's series.
2	Notes on differential forms and line integrals. The language of differential forms.

Hrs	Practice
2	Exercises on the computation, on the representation and on the discussion of the topological and metric properties of the domain of a real function of two real variables.
3	Exercises on the continuity and / or differentiability of a function of two variables.
4	Maximizing and minimizing functions of two variables.
5	Exercises on the calculation of double integrals.
5	Resolution of some classes of differential equations and Cauchy problems.
5	Exercises on the study of the convergence of sequences and series of functions.

MODULE **MATHEMATICAL ANALYSIS - MODULE 1**	
Prof. MICHELE SCIACCA	

SUGGESTED BIBLIOGRAPHY

- M. Bertsch, R. Dal Passo, L. Giacomelli, Analisi Matematica, McGraw-Hill Education, 2014 (ISBN: 8838668949)
- R.A. Adams - Calcolo differenziale I - Casa Editrice Ambrosiana, Milano, ISBN: 978-88-408-1389-9.
- P. Marcellini, C.Sbordone - Analisi Matematica uno - Ed. Liguori, Napoli; ISBN:88-207-2819-2.
- P. Marcellini, C.Sbordone - Esercitazioni di Matematica - Ed. Liguori, Napoli; ISBN: 88-207-1684-4; ISBN: 978-88-207-1704-9.
- Pagani S. Salsa, Analisi Matematica I, Zanichelli, 2014 Bologna; ISBN: 9788808254214.

Approfondimenti
- C. D. Pagani S. Salsa, Analisi Matematica, vol. I Masson, 1990 Milano; ISBN: 978-88-08-09259-5

English version:
- R.A. Adams - Single Variable Calculus - Addison Wesley, ISBN: 978-0201828269.

AMBIT	50292-Matematica, informatica e statistica
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54

EDUCATIONAL OBJECTIVES OF THE MODULE

The fundamental objective of the course is to provide students with the main tools of the Mathematical Analysis such as: real numbers and complex numbers and their properties, study of real functions of real variable (graph, limits and their properties, continuity, derivability and integration) and numerical series.
The training objectives will be:
1. to promote the intuitive and logical abilities;
2. to acquire skills for abstracting and formalizing;
3. to develop the abilities for critical examination and to outline logically the knowledge gained;
4. to be familiar with the application of analyzing and drawing together to some concrete situations;
5. to be familiar with looking for alternative constructive solutions;
6. to be familiar with generalizing the solution to a specific problem in algorithms;
7. to improve the ability to use methods, instruments and mathematical models in different situations;
8. to promote the comprehension of the cross-cutting concepts in order to grasp analogies between different fields.

SYLLABUS

Hrs	Frontal teaching
2	Numerical sets: natural numbers and the principle of induction, rational numbers, real numbers. Extremes of a numeric set. The completeness of the real numbers.
3	Functions of real variable and their properties. Elementary functions: exponential, logarithmic, circular and hyperbolic. Invertible functions. Graphs of elementary functions. Operations with elementary functions.
2	The complex numbers
2	Outlines of topology on the real line. Real intervals. Numerical sequences
3	Limits of functions and sequences. Main properties and review of the most relevant theorems. Asymptotic of a function. Continuous functions in a point. Infinitesimal and infinite.
4	Continuous functions on an interval: the theorem of existence of zeros, the theorem of intermediate values, the Weierstrass theorem, the continuity of the inverse function.
3	Derivability of functions and their properties'. The algebra of the derivatives.
4	Main theorems of the differential calculus. Taylor's formula.
5	Theory of integration: the Riemann integral, the definite integral, the indefinite integral. Methods of integration.
2	Improper integrals
2	Numerical series.

Hrs	Practice
2	Exercises on numerical sets: extremes of a set, solving of real equations and inequalities and equations in a complex field.
3	Exercises on elementary functions
4	Exercises on limits and continuous functions. Search for asymptotes.
5	Exercises on derivatives and their application for the study of the graph of a function.
6	Methods of integration. Calculus of definite integrals and improper integrals.
2	Exercises on numerical series