UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2022/2023
BACHELOR'S DEGREE (BSC)	CYBERNETIC ENGINEERING
INTEGRATED COURSE	MATHEMATICAL ANALYSIS - INTEGRATED COURSE
CODE	19109
MODULES	Yes
NUMBER OF MODULES	2
SCIENTIFIC SECTOR(S)	MAT/05
HEAD PROFESSOR(S)	TRIOLO SALVATORE Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	TRIOLO SALVATORE Professore Associato Univ. di PALERMO GARGANO FRANCESCO Professore Associato Univ. di PALERMO
CREDITS	12
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	Annual
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**GARGANO FRANCESCO** Tuesday 10:00 11:00 Ex dipartimento di Metodi e modelli Matematici, primo piano **TRIOLO SALVATORE** Wednesday 10:00 12:00 Dip Metodi e modelli matematici primo piano.

DOCENTE: Prof. SALVATORE TRIOLO

PREREQUISITES	Classical knowledge of the concepts of mathematical logic. Solution of equation, system of equation, inequalities, system of inequalities. Set theory generalities. Basic knowledge of trigonometry.
LEARNING OUTCOMES	Knowledge and Understanding The student, at the end of the course, will have acquired knowledge and methodologies to address and solve problems of differential and integral calculus. The student must also know and understand the theorems and their proofs on the above topics. Applying knowledge and understanding The student must be able to use the differential and integral calculus in order to solve mathematical problems arising also from classical mechanics. Making judgements The student will develop a critical ability in characterizing the suitable and relevant solution to the proposed problem. The student will acquire the ability to formalize and analyze new problems in full autonomy, both in qualitative way and in rigorous way. The formative objectives will be reached using frontal lessons and problems and exercises solved in classroom. The attainment of the objectives is verified by written test and oral examination. Communication skills The student will acquire the ability to expose in clear and rigorous way, using adequately the disciplinary lexicon, the results of the characterized qualitative solution and problem analysis. The communication abilities will be verified in the oral examination. Learning skills The student will acquire the ability to contextualize own knowledges, eventually adapting in an independent way, in wide and multidisciplinary area of interests.
ASSESSMENT METHODS	The knowledge and the understanding of the student about the contents of the course will be verified through a written test (2 hours) and an oral discussion. In the written test the resolution of four exercises is demanded. The exercises will be structured in several questions in order to determine whether the student has gained knowledge and understanding of the proposed arguments The final evaluation will be scaled according to the following conditions: 30-30 with honors optimal knowledge of the contents of the course, optimal property of language, very good analytic abilities and competence in problem solving; 26-29 good mastery of the contents of the course, very good property of language, good competence in problem-solving ; 24-25 knowledge of base treated contents, discrete property of language, with limited ability to independently apply the competence to solve the proposed problems; 21-23 not have full mastery of the main contents of the course but possesses knowledge, satisfactory property of language, insufficient ability to independently apply the acquired knowledge; 18-20 minimal base knowledge of the contents of the course and of the technical language, most insufficient or null ability to independently apply the acquired knowledge ; no sufficient does not possess an acceptable knowledge of the contents of the presented topics (no sufficient); The assessment will be based on class test + oral. The following score table will be applied: Indicator - Knowledge and competence of contents Descriptor and score range: Excellent 10 Autonomous and effective 8-9 Acceptable 6-7 Fragmentary or partly superficial 4-5 Inadequate 0-3 Indicator - Applicative skill, precision, logical-thematic coherence Descriptor and score range: Excellent 10 Adequate 8-9 Acceptable also if partly driven 6-7 Limited 4-5 Inadequate 0-3 Indicator - Expression and terminology, reprocessing skills and multi-disciplinary connections Descriptor and score range:

	Excellent 10 Effective and well-structured 8-9 Generally satisfactory 6-7 Hesitant and rough 4-5 Inadequate 0-3
TEACHING METHODS	The course consists of frontal lessons and discussion in which illustrative problems are resolved.

MODULE
MATHEMATICAL ANALYSIS - MODULE 2

Prof. FRANCESCO GARGANO

SUGGESTED BIBLIOGRAPHY

Libri di testo /textbooks:
- M. Bramanti, C.D. Pagani, S. Salsa: Analisi matematica 2, Ed. Zanichelli, ISBN 9788808122810
- S. Salsa, A. Squellati: Esercitazioni di Analisi Matematica 2, Ed. Zanichelli, ISBN 9788808218964
- Bertsch-Dal Passo: Elementi di Analisi matematica 2, McGraw-Hill, ISBN 9788838668944
- Adams, Essex, Calculus: A Complete Course, Pearson, ISBN 978-0134154367 (English version)

AMBIT	50283-Matematica, informatica e statistica
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54

EDUCATIONAL OBJECTIVES OF THE MODULE

At the end of the course, the student will acquire the knowledge on the main methodologies applied to infinitesimal, differential and integral calculus for function of several real variables and vector functions. In particular, the student will be able to understand the problems that arise from the need to create a rigorous language using the logical-deductive method to account for mathematical problems inherent to the topics of the course. The student will also be able to solve problems deriving from physics and technologies typical of cybernetics engineering, and to represent and contextualize them in the appropriate mathematical language, deriving models expressed as differential problems. These objectives are in line with the educational objectives of the Course of Studies in Cybernetics, which provides for the training of a computer engineer with skills that allow him to identify, formulate and solve problems that require an interdisciplinary approach based on the rigorous the scientific-mathematical method

SYLLABUS

Hrs	Frontal teaching
10	Differential equations Definition and generality of the differential equations. First order linear equations. Cauchy problem and existence and uniqueness theorem of the solution of the Cauchy problem. Equations with separable variables. Second order equations: Structure of the general integral. Existence and uniqueness theorem for the Cauchy problem. Method of similarities.
10	Differential calculus Generalities on functions of several variables. Topology in R^n. Definition of limits and continuous function for functions of several variables. Uniqueness of the limit. Weirstrass theorem. Theorem of zeroes. Sign permanence theorem. Partial derivatives, differentiable functions. The gradient vector. Relation between differentiability and continuity for functions of two real variables. Directional derivatives. Definition of a plane tangent to the graph of a function of two real variables. Differentiable function. Schwarz's theorem. Hessian matrix. Taylor's formula . Derivatives of higher order than the second. Definition and classification of critical points. Definition of maximum or minimum constrained point for a function of two variables.
4	Curves in space. Regular curves. Length of a curve. Line integral of first species. Physical applications.
6	Double integrals: definition and calculation as iterated integrals. Normal domains and regular domains. . Change of variables in double integrals. Jacobian formula, computation of integrals in polar, spherical and cylindrical coordinates. Triple integrals: integration by threads and by layers.

Hrs	Practice
10	Differential equations
8	Differential calculus
6	Integral calculus

MODULE
MATHEMATICAL ANALYSIS - MODULE 1

Prof. SALVATORE TRIOLO

SUGGESTED BIBLIOGRAPHY	
M. Bertsch, R. Dal Passo, L. Giacomelli, Analisi Matematica (2Ed) McGraw-Hill Isbn 8838662819 Per Approfondimenti: M. Bramanti, C. Pagani, S. Salsa Analisi Matematica I P. Marcellini, C. Sbordone , Elementi di Analisi Matematica I Liguori Editori. Mathematical Analysis I Edizione Inglese | di V. A. Zorich , Roger Cooke, e al Per le esercitazioni: C. Marcelli, Analisi matematica 1 esercizi con richiami di teoria, Pearson	
AMBIT	50283-Matematica, informatica e statistica
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
EDUCATIONAL OBJECTIVES OF THE MODULE	
-Knowledge and understanding The student must know and understand the basic concepts of the course. Know and be able to work in different numerical sets, know, understand and be able to apply knowledge relating to succession, elementary functions, limit of sequences and functions, differential and integral calculus. -Applying knowledge and understanding The student will be able to use mathematical language, apply the acquired knowledge in solving proposed problems and generally include the use of mathematical methods in the applied sciences. -Making judgment At the end of the course the student will have specific knowledges in identifying the most relevant technical solutions in relation to different problems. at the same time understand how to use the knowledge acquired in the study of other disciplines. -Communication skill During lectures and exercises the student will be urged to interact with relevant questions to clarify any doubts and to develop capacity to apply the techniques learned to other scientific subjects. -Learning ability Ability to attend, using the knowledge acquired in the course. Knowledge of the differential and integral calculus for functions of one real variables. The student will be able to study of the graphs of elementary functions, to solve integration problems of elementary character, to discuss the nature of numerical sequences, to state and prove basic theorems of Mathematical Analysis.	

SYLLABUS

Hrs	Frontal teaching
4	Axioms of real numbers. natural, integers and rational numbers. Set theory. Maximum, minimum, supremum and infimum of a set. Uniqueness of the maximum and minimum of a set. Theorem of existence of the supremum and infimum of a set
6	Functions of a real variable. Surjective, bijective functions. Composte mappings. Monotonic functions. The exponential and logarithmic functions. Powers functions. The circular functions
2	real sequences.
5	Continuous functions. Discontinuities of a function. Properties and theorems of limits of functions. The intermediate value theorem
9	Differentiation at a point. The chain rule theorem. Differentiation of the inverse mapping. Convex functions. Properties of derivatives functions. Local minimum and maximum. Rolle Theorem. Darboux continuity. The mean value theorem. Taylor theorem with Lagrange and Cauchy remainder. Higher derivatives of order n. Convex functions. L'Hopital rule. Taylor espansion
4	Integration and elementary integrals. Upper and lower Riemann integrals. Riemann integrable functions. Algebraic property of integrable functions. Mean value theorem. The fundamental theorem of calculus. Change of variable formula. Integration by parts.

Hrs	Practice

2	Exercises on real numbers.
3	functions
7	Exercises on limits of sequences and functions.
6	Exercises on continuity and differentiation at a point.
6	Exercises on integrals