UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2020/2021
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);
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

M. Bramanti, C.D. Pagani, S. Salsa: Analisi matematica 2 Ed. Zanichelli, Bologna, 2009 M. Bramanti: Esercitazioni di Analisi Matematica 2 Ed. Esculapio, Bologna, 2012

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

EDUCATIONAL OBJECTIVES OF THE MODULE

The student at the end of the course will acquire the knowledge on the main topics and methodologies on infinitesimal, differential and integral calculus for fields of more variables. In particular, the student will be able to understand the issues arising from the needing to create a rigorous language using the logical-deductive method in order to deal with mathematical problems related to the topics of the course. The students will be also able to solve problems arising from physics and from engineering cybernetics and of the information, and to contextualize them in the correct mathematical language. These objectives are in agreement with the educational objectives of the of Engineering cybernetics, which deal with the formation of an engineer with expertise useful to identify, formulate a solve problems which require an interdisciplinary approach based on the rigorous scientific-mathematical method

SYLLABUS

Hrs	Frontal teaching
6	Trigonometric Series and Fourier Series Total convergence of a set of functions: definition, continuity theorems, and derivation of the sum of a series of continuous or derivable functions. Convergence radius, infinite derivation of termination of the power series in the convergence range. Trigonometric series polynomials; Convergence criteria for trigonometric series: total convergence, punctual convergence criterion Vector spaces with scalar product, orthogonality and projection relationships. Trigonometric system: orthonormal relationships; Fourier coefficients of an integrable function. Fourier partial sum and geometric characterization. Bessel's Inequality and Riemann-Lebesgue's Theorem. Fourier Series: Quadratic Media Convergence and Parseval Equality. Regular stroke functions and Fourier series punctual convergence theorem for regular functions at intervals. Fourier series in any interval; Fourier coefficients of even or odd functions.
7	Definition and generality of the differential equation of order n. First Order Equations and resolving techniques. Cauchy's problem .Existence and uniqueness theorem of Cauchy's problem. Separate variable equations. Second Order Equations and the general solution. Theorem of existence and uniqueness for Cauchy's problem. Similarity Method for non homogeneous problem.
2	Curves on the space. Simple curve. Closed curve. Regular curve. Length of a curve. Line integral of the first kind
8	Differential calculus. Generality on the functions of more variables. Graph. Topology in Rn. Definition of limit and continuous function for more variables. Unicity of the limit. Algebra of Limits. Weirstrass Theorem. Zero theorem. Sign permanence theorem. Partial Derivatives, Derivable Functions. The gradient vector. Directional Derivatives. Definition of plan Tangent to the graph of a function of two real variables. Schwarz theorem. Hessian Matrix. Taylor's Formula to Second Order. Orders of higher order than the second: extension of the Schwarz theorem. Definition of minimum and minimum point, local and global, for more variable functions.. Definition of maximum or minimum point for a function of two variables. Lagrange Multiplier Theorem.
4	Integral calculus Multiple Integration. Double Integral: Definition and Calculation as Iterates. Regular Domains. Calculus of areas, center of gravity and moments of inertia of flat planes. Change of variables. Jacobian formula, calculating integrals in polar, spherical and cylindrical coordinates.
3	Definition of rotor of a three-dimensional vector field. Rotor of a two-dimensional field. Irrotational fields. Definition of divergence of a three- or n-dimensional vector field. Solenoid fields. Differential identities involving div, rot, grad and vector fields. Divergence and rotor theorem.

Hrs	Practice
3	Trigonometric and Fourier Series
8	Solution of differential equations of first and second order
6	Differential CAlculus
7	Integral calculus

MODULE
MATHEMATICAL ANALYSIS - MODULE 1

Prof. SALVATORE TRIOLO

SUGGESTED BIBLIOGRAPHY

M. Bertsch, R. Dal Passo, L. Giacomelli, Analisi Matematica (2Ed) McGraw-Hill
Per Approfondimenti:
M. Bramanti, C. Pagani, S. Salsa Analisi Matematica I
P. Marcellini, C. Sbordone , Elementi di Analisi Matematica I Liguori Editori.
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.
4	Continuous functions. Discontinuities of a function. Properties and theorems of limits of functions. The intermediate value theorem
8	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