UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria		
ACADEMIC YEAR	2021/2022		
BACHELOR'S DEGREE (BSC)	DIGITAL ENTERPRISE INNOVATION ENGINEERING		
INTEGRATED COURSE	MATHEMATICAL ANALYSIS - INTEGRATED COURSE		
CODE	19109		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	MAT/05		
HEAD PROFESSOR(S)	DALLA RIVA MATTEO	Professore Associato	Univ. di PALERMO
OTHER PROFESSOR(S)	DALLA RIVA MATTEO CORSO ROSARIO	Professore Associato Ricercatore a tempo determinato	Univ. di PALERMO Univ. di PALERMO
CREDITS	12		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	1		
TERM (SEMESTER)	Annual		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**CORSO ROSARIO** Tuesday 14:30 16:00 Dipartimento di Matematica e Informatica, Via Archirafi 34, studio 102, 1° piano, contattare il docente per email. **DALLA RIVA MATTEO** Wednesday 14:30 15:30 da stabilire		

DOCENTE: Prof. MATTEO DALLA RIVA

PREREQUISITES	Common mathematics program of the Italian secondary school. Arithmetics and algebra. Basic properties of integer, rational, and real numbers numbers and of their operations. Prime numbers. Absolute value. Powers and radicals. Logarithms and exponentials. Symbolic calculations. Polynomials: operations, factorization, decomposition. Quadratic, linear, and reducible algebraic equalities and inequalities. Systems of equations. Rational equalities and inequalities with fractions and radicals. Calculations with the use of logarithms. Logarithmic and exponential equalities and inequalities. Geometry of the plane and the space. Segments, angles, lines, and planes. Principal plane geometric figures: properties, perimeters, and areas. Properties of the principal solid geometric figures and related volumes and surface areas. Basics of analytical geometry. Cartesian coordinates. Equation of the line and of the circumference. Equations of simple geometric figures such as ellipses, parabolas, and hyperbolas. Plane trigonometry. Properties of the sine, cosine, and tangent functions. Main trigonometric formulas: addition, subtraction, duplication, bisection. Trigonometric equations and inequalities. Relations between elements of a triangle.
LEARNING OUTCOMES	Knowledge and understanding: At the end of the course students will be well acquainted with the basic elements of differential calculus for functions of one real variable and many real variables, with integration techniques for real functions, and will have some knowledge about ordinary differential equations. More specifically, they will have a clear idea of the main global and local properties of functions and they will know and understands notions such as those of limit, continuity, derivative, and definite and indefinite integrals. Ability to apply knowledge and understanding: As a general fact, students will improve their logical reasoning and learn how to address problems in a scientifically rigorous way. In addition, they will learn how to solve problems graphically and qualitatively. More specifically, they will be able to apply calculus techniques to compute limits, study the properties of functions, compute integrals, and find solutions to differential equations. Evaluative judgement: Students will be able to able to argue both by analogy and by extension. Doing so they will learn how to generalize the ideas and techniques acquired in class to situations and problems that have not been explicitly addressed. They will develop the habit of considering more than one solution to the same problem, and sometimes even more than one point of view. In particular, they will start searching for original solutions. Eventually, they will become more independent in reading mathematic books and they will learn how to acquire new knowledge by themselves. Communication skills: Students will learn how to describe and illustrate problems related to the topics of the course. They will know how to write solutions in rigorous and correct way. Learning skills: As a general fact, students will learn how definitions and theorems raise from the study of specific examples (a process called "inductive logic") and, in turn, how specific cases can be studied under the light of a general theory (the so-called "deductive reasoning"). This training will be of great help when facing more advanced mathematics topics and, more in general, will lead students to the achievement of a complete autonomy and capacity of discernment, a precious toll in their engineering career.
ASSESSMENT METHODS	There will be a written test. The aim is to assess students' knowledge and skills in the different topics of the program. The optimal final grade is 30 points. Method of evaluation of the written test. The written test usually consists of 4 problems. Of these, it is likely that one will be a differential equation and one will be the analysis of a function of more variables. One can also expect exercises on limits or the analysis of a function of one real variable (possibly dependending on one or more parameters). Very common are also exercises on the computation of indefinite and definite integrals. In the text of the test, the instructor will indicate the partial score of each single problem (or part of a problem). The sum of all partial scores is 30 points. In addition, for each problem, the instructor will prepares an evaluation key with the partial scores of each step of the solution. For example, if the problem is the study of a real function f(x), then the key indicates the points obtained for computing the domain, the sign, the limits of f, the derivative f'(x), the monotony properties of f, etc. Precisely because the exam does not include an oral test, the written test has no multiple choice questions. Therefore, students are required to write all

	calculations, intermediate arguments, and explanations of the various steps of the solution of an exercise. The final result alone is not sufficient! The final evaluation of the written test takes into account both the knowledge of the theory involved in the solution of the problems and of computation mistakes related to basic mathematics, which is assumed to be known as prerequisite of the course. To obtain 30 points students must have written a perfectly correct solution to all required exercises. In case, these students might be required to solve an additional exercise, as a check. Honors (lode) is given to those students that show a confidence in handling the topics of the course and the ideas and methods learned, to the point of knowing how to solve a new problem that has not been explained in class. Students may pass the exam even if the score obtained in the written test is less than 18 but greater than or equal to 16, provided that they correctly solve one or more additional exercises. The reason why the exam consists only of a written test, without a oral test, it is the fact that, in most cases, students of the first year in Engineering does not master the technical language to expose definitions, statements, demonstrations, and other aspects of theory. On the other hand, students are often able to carry out exercises in a more or less correct way. As mentioned above, just in the case of written tests that are almost sufficient, the instructor may require a supplement of "investigation" not with an oral interview, but with one or more additional written exercises.
TEACHING METHODS	In-person lessons In-class exercises

MODULE
MATHEMATICAL ANALYSIS - MODULE 1

Prof. MATTEO DALLA RIVA

SUGGESTED BIBLIOGRAPHY

• Testo di riferimento (reference textbook): M. Bertsch, R. Dal Passo, L. Giacomelli, Analisi Matematica, seconda edizione, McGraw-Hill, Milano, 2011. ISBN: 978-88-386-6894-4
• Eventuale libro di esercizi (optional exercises book): P. Marcellini - C. Sbordone, Esercizi di Matematica, Primo Volume Parte 1, Liguori, Napoli, 2013. ISBN: 978-88-207-6351-0
• Eventuale libro di esercizi (optional exercises book): P. Marcellini - C. Sbordone, Esercizi di Matematica, Primo Volume Parte 2, Liguori, Napoli, 2017. ISBN: 978-88-207-5252-1

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

EDUCATIONAL OBJECTIVES OF THE MODULE

Knowledge and understanding: At the end of the course students will be well acquainted with the basic elements of differential calculus for functions of one real variable. More specifically, they will have a clear idea of the main global and local properties of functions and they will know and understands notions such as those of limit, continuity and derivative.

Ability to apply knowledge and understanding: As a general fact, students will improve their logical reasoning and learn how to address problems in a scientifically rigorous way. In addition, they will learn how to solve problems graphically and qualitatively. More specifically, they will be able to apply calculus techniques to computate limits and study the properties of a function.

Evaluative judgement: Students will be able to able to argue both by analogy and by extension. Doing so they will learn how to generalize the ideas and techniques acquired in class to situations and problems that have not been explicitly addressed. They will develop the habit of considering more than one solution to the same problem, and sometimes even more than one point of view. In particular, they will start searching for original solutions. Eventually, they will become more independent in reading mathematic books and they will learn how to acquire new knowledge by themselves.

Communication skills: Students will learn how to describe and illustrate problems related to the topics of the course. They will know how to write solutions in rigorous and correct way.

Learning skills: As a general fact, students will learn how definitions and theorems raise from the study of specific examples (a process called "inductive logic") and, in turn, how specific cases can be studied under the light of a general theory (the so-called "deductive reasoning"). This training will be of great help when facing more advanced mathematics topics and, more in general, will lead students to the achievement of a complete autonomy and capacity of discernment, a precious toll in their engineering career.

SYLLABUS

Hrs	Frontal teaching
3	real numbers
7	real functions
10	limits and continuous functions
10	One dimensional differential calculus

Hrs	Practice
2	real numbers
6	real functions
8	limits and continuous functions
8	One dimensional differential calculus

MODULE
MATHEMATICAL ANALYSIS - MODULE 2

Prof. ROSARIO CORSO

SUGGESTED BIBLIOGRAPHY

Michiel Bertsch, Roberta Dal Passo, Lorenzo Giacomelli, Analisi matematica, , McGraw-Hill Education, seconda edizione, 2011 EAN: 9788838662812.

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
topics, methodologies on infinitesimal differential calculus for functions of two or 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 to deal with intuitively simple math problems. The students will be also able to understand simple physical problems and to convert them in the correct mathematical
language, for instance through differential equation.

SYLLABUS

Hrs	Frontal teaching
1	Objectives of the discipline.
1	Sequences of functions. Power series.
2	Topology of the real vector space R^n.
1	Differential equations.
4	Limits for functions of multiple real variables: definitions, main properties and theorem. Continuity of a function.
12	Differential calculus for functions of multiple real variables.
9	Integration theories.

Hrs	Practice
5	Sequences of functions. Power series.
7	Differential equations.
6	Differential calculus.
6	Integration theories.