UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

DIPARTIMENTO DI FARMACIA-SCIENZE DEL FARMACO

General information	
Academic subject	***Mathematics***
Degree course	*Pharmaceutical Chemistry and Technology*
Year of study	*2021-22*
European Credit Transfer and Accumulation System (ECTS)	7
Language	*Italian*
Academic Year	*2021-22*
Academic calendar (starting and ending date)	*November 2021 – Mary 2022*
Attendance	*compulsory*

Professor/ Lecturer	
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Tutoring (time and day)	To be arranged by mail

Syllabus	
Learning Objectives	*The course aims to provide an introduction to the hypothetical-deductive method, reinforcing the basic mathematical knowledge regarding number systems, equations and inequalities, representation of curves in the Cartesian plane and presenting the following topics of mathematical analysis: elementary functions, limits, derivatives, integrals, hints of differential equations.*
Course prerequisites	*Being a first year exam, there are no specific prerequisites other than those required for access to the degree course.*
Contents	*SETS, NUMBERS, FUNCTIONS* *Basics of logic, set theory, fractions and operations. Real number axioms. Existence of real, irrational, solution to x^2=2. Bernoulli inequality, real intervals. Function graphs and properties: invertibility, monotony, symmetries, periodicity. Extension, restriction and reduction of a function.* *Absolute value, distance, triangle inequality. Bounded sets, upper and lower bounds, uniqueness theorem of the maximum and of the minimum, existence theorem of supremum and infimum. Unboundedness of the integers in the real numbers. Density of the rationals in the real numbers. Elementary functions and their properties, solving methods for inequalities.* *SEQUENCES* *Uniqueness theorem of the limit of a sequence, of the boundedness of convergent sequences, sum and product of bounded, vanishing and convergent/divergent sequences. Persistence of the sign of convergent sequences. Regularity theorem of monotone sequences. Euler number. Proof of basic limits. Subsequences and Bolzano-Weierstrass theorem.* *FUNCTION LIMITS AND CONTINUOUS FUNCTIONS* *Limit of a function. Right-hand and left-hand limit. Operations with limits. Continuity. Continuity of the composed function. Continuity of elementary functions. Sequence limits obtained by the continuity. Continuous extension. Persistence of the sign of a continuous function. Bolzano existence theorem of the zeroes. Continuous images of an interval. Weierstrass theorem on the existence of the maximum/minimum. Continuity of the inverse function (without proof).*

	Uniformly continuous functions. Cantor theorem on the uniform continuity on bounded closed intervals. Exercises on the function limits. *DIFFERENTIAL CALCULUS AND APPLICATIONS* *Difference quotient, differentiability, right-hand and left-hand differentiability, further derivatives. Derivative of the sum. Continuity of differentiable functions. Derivative of the product and of the reciprocal function. Derivative of the composition of functions (without proof). Derivative of the inverse function. Derivatives of the elementary functions. Local maximum and minimum points. Fermat theorem and counterexamples. Rolle and Lagrange theorems. Increasing and nondecreasing criteria for differentiable functions. Primitive functions on intervals. Tangent line. Convex differentiable functions and inflection points. Convexity criteria for differentiable functions. De L' Hôpital rule and Taylor formula. Taylor expansion of elementary functions. Exercises on the graph of a function.* *RIEMANN-INTEGRABLE FUNCTIONS AND INTEGRATION* *Partition of a set. Integrals and aeras. Riemann-integrable functions and equivalent definition. Properties of the Riemann integral: additivity, linearity, positivity. Inequality with absolute value and integrals. Integrability theorem of continuous functions. Integral average theorem of continuous functions. Continuity of the integral function. Fundamental theorem of calculus. Primitives and definite integral of a continuous function. Indefinite integrals. Integration by parts and by change of variable. Integration methods of rational functions. Exercises on integrals.* *DIFFERENTIAL EQUATIONS AND APPLICATIONS* *Linear Differential Equations (LDE) of first order and their general solution. Cauchy problem for LDE of first order and its solution, proof of the uniqueness. LDE models of first order: heat losing and oxygen debt. Homogeneous equations of second order with constant coefficients: harmonic oscillator and damped harmonic oscillator. Uniqueness of the solution for the harmonic oscillator. Existence, uniqueness and losing of the uniqueness for the Cauchy problem for Bernoulli differential equations and differential equations with separable variables. Model for the speed of a chemical reaction. Mathematical models in population dynamics. Spread of an infection. Basics of the Michaelis-Menten formula and of the Hill kinetics: applications to the system of differential equations to the conversion of a substrate in a product via catalyzation, application to the comparison of the logistic growth of the tumor cells and the reaction of the effector cells. Basics of the SIS, SIR and SEIR model for the spread of an infection. Exercises on LDE and related Cauchy problems. Exercises on Cauchy problems for nonlinear differential equations of first order of Bernoulli type and with separable variables.*
Books and bibliography	*Carlo Sbordone, Paolo Marcellini, Calcolo, Liguori ed.*
Additional materials	*Lecture notes.*

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
175	*60*	*10*	*105*
ECTS			
7	*6*	*1*	

Teaching strategy	
	Frontal lessons and excercises
Expected learning outcomes	
Knowledge and understanding on:	○ Basics in mathematics ○ Understanding of mathematical problems
Applying knowledge and understanding on:	○ Understanding of mathematical tools and models ○ Applying the basic tools to solve abstract problems
Soft skills	• *Making informed judgments and choices* ○ Applying the mathematical knowledge to other fields of interest ○ Applying the mathematical tools to solve problems • *Communicating knowledge and understanding* ○ Use of a correct and precise formal logical-mathematical language ○ Ability to introduce and prove a theorem • *Capacities to continue learning* ○ Modeling real-life problems

Assessment and feedback	
Methods of assessment	*As a prerequisite for passing the exam, the student must be able to correctly and completely perform the exercises proposed in the practical test, chosen from those carried out in the classroom. The time allotted for carrying out the practical test depends on the assigned exercises, but is never less than 30 minutes.* *The results of the practical test are communicated by esse3 or by e-mail, if the esse3 system is not available. The student's ability to present theorems and proofs during the theoretical test, arguing and explaining the logical steps, in writing or on the blackboard, contributes to determining the final evaluation.* *No material other than pen is required to take the tests, in particular no calculators or tables are required.*
Evaluation criteria	• *Knowledge and understanding* ○ Correctness and completeness of the presentation of the theoretical arguments • *Applying knowledge and understanding* ○ Correctness and completeness of the exercise solving • *Autonomy of judgment* ○ Self-evaluation of the errors in the exercises and in the theoretical expositions and capability to fix them • *Communicating knowledge and understanding* ○ Use of a correct and rigorous formal mathematical language • *Capacities to continue learning* ○ Knowledge of the mathematical tools and capability to correctly use them
Criteria for assessment and attribution of the final mark	*The final grade is awarded out of thirty. The exam is passed when the grade is greater than or equal to 18. The outcome of the practical test contributes to determining 80% of the final grade (24/30). The theoretical test is accessed with 14 points obtained out of 24 available (58%). The outcome of the theoretical test contributes to determining 20% of the final grade (6/30). Honors are awarded if a score of 30 points is achieved between the practical and theoretical tests and a correct answer is given to the question specifically indicated "for honors"*
Additional information	