Fundamentals of Mathematics (2500201)

General Information

School	ETSECCPB
Departments	Departament d'Enginyeria Civil i Ambiental (DECA)
Credits	6.0 ECTS
Programs	GRAU EN ENGINYERIA AMBIENTAL (pla 2020)
Course	2024/25

Main teaching language at each group

- Group 11 English (Q1)
- Group 12 English (Q1)

Faculty

Responsible Faculty: Jose Luis Diaz Barrero
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Objectives of Education

Mathematical concepts are discussed to understand relationships between different environmental variables. Emphasis is placed on a block of basic mathematical tools: matrix operations, solving linear systems of equations, derivation and integration of one-variable functions, plane and space geometry.

1. Manage trigonometric functions including their derivation and integration. Ability to analyze sequences and series in the context of engineering.
2. Solve maximum and minimum problems using differential calculus related to simple engineering problems.
3. Solve integrals of one variable, looking for a relationship with simple engineering problems.

Mathematical Foundations. Knowledge of real numbers. Knowledge of successions and calculation of limits. Knowledge of numerical series and convergence. Knowledge of function theory including continuity and limit analysis. Differential calculus knowledge of variable functions real including maximum and minimum problems in simple engineering problems and optimization. Knowledge of integral calculation of functions of a real variable. Trigonometry knowledge.

At the end of the course, the student will have had to: a) achieve knowledge and computational fluency on matrices and systems of linear equations, basic linear transformations in plane and space, differential and integral calculus of real functions of real variable; b) to acquire basic knowledge about the use of Matlab, having had to practice with problems posed in some of the subjects that configure the syllabus of the subject; c) get started in the numerical resolution of some problems.

Competencies

Especific

Recognize the biological bases and foundations of the plant and animal field in engineering: notions of genetics, biochemistry and metabolism, physiology, organisms and environment, population dynamics, flows of matter and energy and changes in ecosystems, biodiversity, principles of the kinetics of microbial growth and reactor theory.
Solve mathematical problems that may arise in engineering by applying knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, optimization, ordinary differential equations.

Obtain basic knowledge about the use and programming of computers, operating systems, databases and basic numerical calculation and applied to engineering.
Manage the basic concepts about the general laws of mechanics and thermodynamics, concept of field and heat transfer, and apply them to solve engineering problems.
Apply the basic principles of general chemistry, organic and inorganic chemistry and their applications in engineering.
Describe the global functioning of the planet: atmosphere, hydrosphere, lithosphere, biosphere, anthroposphere, biogeochemical cycles (C, N, P, S), soil morphology and apply it to problems related to geology, geotechnics, edaphology and climatology.

Generic

Identify, formulate and solve problems related to environmental engineering.
Apply the functions of consulting, analysis, design, calculation, project, construction, maintenance, conservation and exploitation of any action in the territory in the field of environmental engineering.

Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	30.0 h	50.00 %
	Medium group	30.0 h	50.00 %
	Laboratory classes	0.0 h	0.00 %
	Guided Activities	0.0 h	0.00 %
Self Study		90.0 h	

Contents

Lesson 1: Review of basic concepts.

Review of basic concepts and matehmatical tools from High School Mathematics. Real and complex numbers.
Solving problems of Lesson 1
Solving problems in class by the students, under the supervision of the teacher.

Specific Objectives

The objective is to try to unify the notation and knowledge of students coming from high school as a starting point to begin the degree in marine sciences and technologies.
Learn the benefits of using an appropriate mathematical notation to solve mathematical problems and writing theirs solutions.
Help students individually in those difficulties they may encounter when trying to solve a problem

Lesson 2: Real functions of a real variable

Functions. Operations with functions. Limits and continuity. Elementary functions. Numerical sequences and series.
Solving problems of Lesson 2
Solving problems in class by the students, under the supervision of the teacher.

Specific Objectives

To understand the definiton of a function and to work with funcions of one real variable.
Learn the appropriate techniques to solve problems in lesson 2 and write their solutions.
Help students individually in those difficulties they may encounter when trying to solve a problem

Lesson 3: Fundamentals of linear algebra, geometry and probability

Systems of linear equations and matrices. Affine geometry of the plane and space. Counting and probability techniques.
Problems of Lesson 3.
Solving a problem in class by the students, under the teacher's supervision.

Specific Objectives

Review the basic concepts of linear algebra and geometry and probability in finite spaces.
Learn the appropriate techniques to solve problems in Lesson 3 and write their solutions.
Help students individually in those difficulties they may encounter when trying to solve a problem.

Lesson 4: Differential calculation of functions of a variable

Derivative. Rolle's and mean value theorems. Applications. Extremes.
Solving problems in class.
Solving problems in class by the students, under the supervision of the teacher.

Specific Objectives

Review the basic concepts of the differential calculus of a variable.
Know how to identify when a function is or is not differentiable at a point. Solving extremes and optimization problems.
Help students individually in those difficulties they may encounter when trying to solve a problem.

Lesson 5: Real functions of real variable: integral calculus

The integral defined as the area under a curve. Primitives and Barrow's rule. Calculation of areas and volumes of bodies of revolution. Numerical calculation of integrals (trapezoids, Simpson).
Solving a class of problems of Lesson 5.
Solving a problem in class by the students, under the teacher's supervision.

Specific Objectives

Learn to interpret the integral defined as area under a curve, and the relationship between integrals and primitives. See how the value of an integral can be numerically approximated. See applications of the integral to the calculation of areas, volumes of bodies of revolution, etc.
Learn the benefits of integral calculus. Knowing how to calculate integrals defined both analytically and numerically.
Help students individually in those difficulties they may encounter when trying to solve a problem.

Evaluations

Teaching Methodology

Theoretical, problem-solving and practical classes will be given. The subject is face-to-face and the class work will be evaluated, in addition to the exams proposed for the course. Class participation will be valued very positively. Class attendance will not be enough to pass the course, which means that the student must spend an average of 4 hours a week studying outside the classroom.

Grading Rules

(*) The evaluation calendar and grading rules will be approved before the start of the course.

Two exams are held throughout the semester:
* EP1 = Partial Exam 1, weight = 50% of the grade for the subject.
* EP2 = Partial Exam 2, weight = 50% of the grade for the subject. If the grade obtained (EP1 + EP2) / 2 exceeds the approved one, that is, it is greater than or equal to 5 points out of 10, then the subject is approved per course. Otherwise, you have to go to the reevaluation exam. The re-evaluation (R) will consist of a single exam covering the entire course content. The maximum grade for the re-evaluation will be five (5.0) and the final grade for the course will be the maximum grade between the ordinary evaluation and the re-evaluation exam.

-Mark EP1=0.25*Theory+0.25*Practical Exercises+0.5*Problems.
-Mark EP1=0.25*Theory+0.25*Practical Exercises+0.5*Problems.
-Mark R=0.25*Theory+0.25*Practical Exercises+0.5*Problems.

Test Rules

Each assessment activity not performed in the scheduled period will be assigned a score of zero.

Unless expressly authorized by the responsible teacher, a calculator, mobile phone, notes, book, or any other device (electronic or otherwise) that allows storage, reception may not be carried out for the face-to-face assessment tests. , send or consult information about the subject and / or manipulate mathematical expressions.

Office Hours

Face-to-face: to be agreed with the student. You must make an appointment in advance. Non-contact: by e-mail whenever the student wants to use it.

Bibliography

Basic

- Hass, J. Thomas' Calculus. Fifteenth edition in SI Units. Harlow, Essex: Pearson, 2023. ISBN 9780137615582.
- Strang, G. Introduction to linear algebra. 6th ed. Wellesley: Cambridge Press, 2023. ISBN 9781733146678.

Complementary

- Burgos, J. Álgebra lineal y geometría cartesiana. 3a ed. Madrid: McGraw-Hill, 2006. ISBN 8448149009.
- Apostol, Tom A. Mathematical Analysis. [Beijing]: China Machine Pres, 2004. ISBN 9787111146896.