Fundamentals of Mathematics for Environmental Science (250554)

General Information

School	ETSECCPB
Departments	Departament d'Enginyeria Civil i Ambiental (DECA)
Credits	6.0 ECTS
Programs	GRAU EN CIÈNCIES I TECNOLOGIES DEL MAR (pla 2018)
Course	2025/26

Main teaching language at each group

- Group 10 Catalan (Q1)

Faculty

Responsible Faculty: Antonio Rodriguez Ferran
Faculty: Juan Salvador Latorre Sánchez, Antonio Rodriguez Ferran, Esther Sala Lardies

Objectives of Education

In this course, some basic mathematical aspects will be provided to understand the existing relationships between different environmental parameters. Emphasis will be placed on teaching a block of basic mathematical tools: matrices, differential calculus, integral calculus, and geometry.

At the end of the course, the students should have:

a) obtained knowledge and calculus skills on matrices and systems of linear equations, basic linear transformations in the plane and space, differential and integral calculus of real-valued real functions;

b) acquired basic knowledge about the use of Matlab, having had to practice with problems posed in some of the subjects that make up the course program;

Competencies

Especific

To know and apply the lexicon and concepts of the Marine Sciences and Technologies and other related fields.
Establish a good practice in the integration of common numerical, laboratory and field techniques in the analysis of any problem related to the marine environment.

Generic

Develop a professional activity in the field of Marine Sciences and Technologies.
Address in a comprehensive manner the analysis and preservation of the marine environment with sustainability criteria.

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

Unit 0: Basic notions

- Manipulation of algebraic expressions with parameters.
- Trigonometric functions: sine, cosine and tangent.
- Logarithms.

Unit 1: Functions

- Graphical representation and main features of elementary functions: polynomial, rational, logarithmic, exponential, trigonometric, piecewise functions.
- Operations with functions and transformations f(x)+a, f(x+a).
- Composition of functions.
- Limits for x tending to infinity. Solution of indeterminations infinity/infinity, infinity-infinity: orders of magnitude.
- Limits for x tending to a real value. Lateral limits. Vertical asymptotes. Solution of indeterminations 0/0: simplification and equivalent infinitesimals.
- Continuity of functions.

Unit 2: Differential calculus

- Definition of derivative an its application to compute derivatives of simple functions.
- Interpretation of the derivative as the slope of the tangent line.
- Computation of the derivative of elementary functions: ax, x^p, sin(x), cos(x), ln(x), exp(x).
- Derivative of the sum, the product and the quocient of functions: (f+g)', (fg)', (f/g)'.
- Chain rule.
- Relation between the sign of the derivative and the increase/decrease of a function. Determination of critical points and classification of extrema. Optimisation problems.

Unit 3: Integral calculus

- Computation of primitives of elementary functions: polynomials, exp(x), sin(x), cos(x), 1/x, and those obtained as the compoistion of functions (f'(g(x))*g'(x)).
- Computation of integrals by integration by parts.
- Definite integral and Barrow's rule.
- Applications of the definite integral: computation of areas and volumes of revolution bodies; problems in mathematical modelling.

Unit 4: Algebra and geometry

- Matrices: definition and operations with matrices.
- Determinants of 2x2 and 3x3 matrices.
- Planar linear transformations: rotations, axial symmetries, translations, homotheties, affine transformations.
- Spatial linear transformations.
- Space geometry: definition of straight lines and planes, relative position of two lines, plane intersection.
- Gauss method for the solution of systems of equations. Relation between the solution of a 3x3 system and the intersection of three planes.

Teaching Methodology

Theoretical classes will be given, solving problems and practices. The subject is face-to-face and the work in class will be evaluated, in addition to the exams proposed for the course. The participation in class will be very positive. Class attendance will not be enough to pass the subject, which means that the student must spend about 4 hours a week on a regular basis outside the classroom. Support material is used in the format of a detailed teaching plan through the ATENEA virtual campus: contents, programming of assessment activities and directed learning and bibliography. Each week will consist of 4h-regular sessions + 2h of workshop (where additional questions can be answered and clarified, some other problems can be solved, etc.).

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

Grading Rules

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

The grade for the course will consist of:

- Activities (NA).

- Two exams (NE1 and NE2).

1. Activities (NA) will include, among others, the resolution of problems and the participation in class.

2. The contents of the NE1 and NE2 exams will be in accordance with all the subject taught from the beginning of the course.

- The NE1 exam will be taken approximately halfway through the semester and the subjects taught so far will enter.

- The NE2 exam will be a final exam, where the complete subject taught throughout the course will enter.

The note of the exams will be calculated as:

NE = max (0.3 * NE1 + 0.7 * NE2, NE2)
The final grade for the course will be:

Final Note = 0.25 * NA + 0.75 * NE

Test Rules

Will be discussed at the beginning of the course.

Bibliography

Basic

- Rojo, J. Álgebra lineal. 2a ed. Madrid: McGrawHill, 2007. ISBN 978-84-481-5635-0.
- Hoffman, K.; Kunze, R. Álgebra lineal. México D.F.: Prentice-Hall, 1973. ISBN 9688800090.
- Jarauta, E. Análisis matemático de una variable: fundamentos y aplicaciones. Barcelona: Edicions UPC, 2000. ISBN 8483014106.
- Estela, M.R. Fonaments de càlcul per a l'enginyeria. Barcelona: Edicions UPC, 2008. ISBN 9788483019696.

Complementary

- Burgos, J. Álgebra lineal y geometría cartesiana. 3a ed. Madrid: McGraw-Hill, 2006. ISBN 8448149009.

- Hernández, E.; Vázquez, M.J.; Zurro, M.A. Álgebra lineal y geometría. 3a ed. Madrid: Pearson, 2012. ISBN 978-84-7829-129-8.
- Stoll, M. Introduction to real analysis. Reading, Mass.: Addison-Wesley, 1997. ISBN 0673995895.
- Estela, M.R.; Saà, J. Cálculo con soporte interactivo en moodle. Madrid: Pearson Educación, 2008. ISBN 9788483224809.