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	2024/25

Main teaching language at each group

- Group 11 Catalan (Q1)
- Group 12 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 1: Matrices

Basic definitions and types of matrices. Elemental row operations, Gauss method, rank of an array. Matrix transposed from a matrix; elementary column posts. Systems of linear equations. Elimination of parameters. Determinants.
Definitions of linear and product combinations of matrices. Transposed matrix, determinant and rank of the matrix product. Relationship between matrix product and elementary operations. Regular matrices
Calculation of the inverse matrix by the Gauss method and by determinants. Matrix of a linear application; Rotations and symmetries in the plane and space. Translations. Treatment with Matlab.

Specific Objectives

Learn how to use the matrices to solve certain types of problems. In particular, how to solve systems of linear equations. Use examples to illustrate poorly conditioned systems of linear equations
Learn how to manipulate matrices loosely, and solve the problems for which they are especially useful.
Learn how to use the matrices to solve certain types of problems. In particular, how to solve systems of linear equations. Use examples to illustrate poorly conditioned systems of linear equations

Unit 2: Differential calculus

Elemental functions Limits and indeterminations. Continuity.
Functions defined in pieces. Derivability; Derivation rules, chain rule, logarithmic derivative. Extrema of a function.
Drawing of functions: by hand and with Matlab.

Specific Objectives

Remember the basics of the differential calculation of a variable. Treatment of functions with Matlab.
Know how to identify when a function is or not differentiable at a point. Solve optimization problems.

Unit 3: Integral calculus

The integral defined as an area under a curve. Primitives and Barrow rule. Change of variable.
Calculation of areas and volumes of revolution.
Numerical integration (trapezoidal rule, Simpson). Treatment with Matlab.

Specific Objectives

Learn to interpret the integral defined as an area under a curve, and the relationship between integrals and primitives. See how the value of an integral can be numerically approximated. Calculate integrals with Matlab. See applications of the integral in the calculation of areas, volumes of revolution, etc.
Learn the utilities of the integral calculation. Know how to calculate integrals defined both analytically and numerically.

Unit 4: Planar and space geometry

Affine space concept. Linear varieties: points, straight lines and planes.
Straight line and plane equations. Relative positions.
Perpendicularity. Distance between two linear varieties.
Parameterization of curves.

Specific Objectives

Remember the concepts related to geometry in the plane and space. Acquire knowledge about curve parameterization
Solve problems of incidence, relative position and perpendicularity of linear varieties. Know how to perform the parameterization of some curves
Individual help students in the difficulties that can be encountered when trying to solve a problem

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 mark of the subject will be obtained from:

- Autonomous Work Activities (total mark: NTA, up to 10 points).
- Two exams (E1 and E2, marks: NE1 and NE2, up to 10 points each).

The contents of the exams E1 and E2 will be in agreement with all the material taught from the beginning of the course.

The final grade of the subject will be:

Final Grade= 0,4*NTA + 0,2*NE1 + 0,4*NE2

ADMISSION AND QUALIFICATION CRITERIA FOR REVALUATION:
Students failed in regular evaluation that have been submitted regularly to the evaluation tests of the subject will have the option to carry out a reassessment test in the period set in the academic calendar Students who have already passed the subject cannot carry out re-evaluation exam. The maximum qualification in the case of re-evaluation will be five (5.0). The non-attendance of a student to the test of re-evaluation, celebrated in the fixed period, will not allow the accomplishment of another test with later date. Extraordinary assessments will be made for students who have not been able to complete some of the continuous assessment tests because of their proven accreditation. These tests must be authorized by the corresponding head of studies, at the request of the professor responsible for the subject, and will be carried out within the corresponding teaching period.

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.