Course guide
250554 - FOMATMEDAM - Fundamentals of Mathematics for Environmental Science

Last modified: 20/06/2024

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: BACHELOR'S DEGREE IN MARINE SCIENCE AND TECHNOLOGY (Syllabus 2018). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: ANTONIO RODRIGUEZ FERRAN

Others: Rodriguez Ferran, Antonio
Sala Lardies, Esther

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
13388. To know and apply the lexicon and concepts of the Marine Sciences and Technologies and other related fields.
13390. 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.

Generical:
13380. Develop a professional activity in the field of Marine Sciences and Technologies.
13381. Address in a comprehensive manner the analysis and preservation of the marine environment with sustainability criteria.

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.

LEARNING OBJECTIVES OF THE SUBJECT

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;

STUDY LOAD

Type	Hours	Percentage
Hours medium group	30,0	20.00
Hours large group	30,0	20.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Unit 1: Matrices

Description:
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

Full-or-part-time: 37h 30m
Theory classes: 7h 30m
Practical classes: 7h 30m
Self study : 22h 30m

Unit 2: Differential calculus

Description:
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.

Full-or-part-time: 37h 30m
Theory classes: 7h 30m
Practical classes: 7h 30m
Self study : 22h 30m

Unit 3: Integral calculus

Description:
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.

Full-or-part-time: 37h 30m
Theory classes: 7h 30m
Practical classes: 7h 30m
Self study : 22h 30m

Unit 4: Planar and space geometry

Description:
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

Full-or-part-time: 37h 30m
Theory classes: 7h 30m
Practical classes: 7h 30m
Self study : 22h 30m

GRADING SYSTEM

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.

EXAMINATION 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 [on line]. Barcelona: Edicions UPC, 2000 [Consultation: 29/04/2020]. Available on: http://hdl.handle.net/2099.3/36155. 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 [on line]. 3a ed. Madrid: McGraw-Hill, 2006 [Consultation: 22/01/2021]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4141. ISBN 8448149009.
- Hernández, E.; Vázquez, M.J.; Zurro, M.A. Álgebra lineal y geometría [on line]. 3a ed. Madrid: Pearson, 2012 [Consultation: 12/01/2021]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1210. 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 [on line]. Madrid: Pearson Educación, 2008 [Consultation: 28/10/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4668. ISBN 9788483224809.