Course guide
250559 - MATMEDIAMB - Fundamentals of Mathematics for Environmental Science 1

Last modified: 22/05/2024

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:** Spanish

LECTURER

Coordinating lecturer: PABLO SAEZ VIÑAS

Others: FRANCISCO JAVIER OZON GORRIZ, PABLO SAEZ VIÑAS

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.

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 mathematical aspects will be provided to understand natural environmental processes. Emphasis will be placed on the development of series (power, Fourier, etc.), functions that describe curves in 2 and 3 dimensions, and the introduction of numerical methods for the solution of systems of nonlinear equations.

1.- Relate the ordinary differential equations (ODEs) with environmental processes. Ability to solve ODEs in simple conditions, allowing an analysis of these solutions, including a parametric study.
2.- Problem solving of environmental processes that involve the minimization of multivariable functions, including their integration and analysis.
3.- Use the Fourier series in the resolution of environmental process problems.

This subject deepens the topics covered in Fundamentals for the Environment and introduces some new ones. In general, there is a lot of emphasis on the applications of mathematics to real problems. The theory that is explained is sufficient to understand the process of building models of the various problems that later require the use of numerical calculation software (Matlab) for its effective resolution. The essential objective is to integrate within the subject the modeling and numerical resolution processes necessary for the treatment of real problems. At the end of the course the student must be able to formulate the problem, write a small Matlab code to solve it (using the Matlab functions), interpret the results and be able to represent them graphically.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

Introduction to Matlab

Description:
Loops, conditionals and functions
Practical cases of programming

Full-or-part-time: 40h
Practical classes: 10h
Self study : 30h

Functions of multiple variables

Description:
Representation of functions in Matlab
Partial and directional derivatives. Gradient. Chain rule
Parametric representation of surfaces
Problems in environmental applications

Full-or-part-time: 40h
Theory classes: 8h
Self study : 32h

Ordinary differential equations

Description:
Introduction. Separation of variables
Linear equations with constant coefficients
Problems in environmental applications

Full-or-part-time: 24h
Theory classes: 4h
Practical classes: 4h
Self study : 16h

Evaluation

Full-or-part-time: 9h 36m
Laboratory classes: 4h
Self study : 5h 36m

Functional approximation

Description:
Functional approximation
Least squares
Resolution by numerical methods

Full-or-part-time: 36h
Theory classes: 6h
Laboratory classes: 6h
Self study : 24h

Zero de functions

Description:
Obtaining the zero of a function through numerical methods

Full-or-part-time: 36h
Theory classes: 6h
Practical classes: 6h
Self study : 24h

GRADING SYSTEM

The grade for the course will consist of:

- Practical works (NA).

- Two exams (NE1 and NE2).

1. The practical work (NA) will include, among others, the resolution of problems and the performance of directed work.

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 subject 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

Criteria for re-evaluation qualification and eligibility: students that failed the ordinary evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test or were qualified as non-attending will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.

EXAMINATION RULES.

. Students suspended to the ordinary assessment that have been submitted regularly to the evaluation tests of the suspended 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 qualification as not yet submitted may not be submitted to the re-evaluation test of a subject. The maximum qualification in the case of re-evaluation will be five (5.0). The non-attendance of a student summoned to the test of re-evaluation, celebrated in the fixed period, will not be able to give rise to 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.

BIBLIOGRAPHY

Basic:
- Larson, R.; Hostetler,R.; Edwards, B. Cálculo, Vol I, Vol II. 9a ed. Méxixo: Mc. Graw Hill, 2010. ISBN 9786071502735.
- Larson, R.; Edwards, B.H. Cálculo. 10a ed. Mèxic, D.F: Cengage, 2016. ISBN 9786075220154.
- Zill, D.G. Ecuaciones diferenciales con aplicaciones de modelado. 9a ed. México, D.F.: International Thomson, 2009. ISBN 9789708300551.
- Zill, D.G.; Wright, W.S.; Cullen, M.R. Matemáticas avanzadas para ingeniería [on line]. 4a ed. México: McGraw Hill, 2012 [Consultation: 23/11/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4315. ISBN 9786071507723.
- Herman, E.; Strang, G. Calculus [on line]. Houston, Texas: OpenStax, Rice University, 2016 [Consultation: 13/04/2023]. Available on: https://d3bxy9euw4e147.cloudfront.net/oscms-prodcms/media/documents/CalculusVolume1-OP.pdf. ISBN 9781947172135.
- Rorres, C.; Anton, H. Aplicaciones de álgebra lineal. México: Limusa, 1979. ISBN 9681801792.

Complementary:
- Boyce, W.E.; DiPrima, R.C. Ecuaciones diferenciales y problemas con valores en la frontera. 5a ed. México: Limusa Wiley, 2010. ISBN 9786070501517.