

Course guides

820008 - ACM - Algebra and Multivariable Calculus

Last modified: 08/07/2020

Unit in charge: Barcelona East School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Compulsory subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2020 **ECTS Credits:** 6.0 **Languages:** Catalan, English, Spanish

LECTURER

Coordinating lecturer: FAYÇAL IKHOUANE EL MOUSTACHIR - MARGARIDA MITJANA RIERA

Others: Primer quadrimestre:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. Solve mathematical problems that may arise in engineering. Apply knowledge of linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial differential equations; numerical methods; numerical algorithms; statistics and optimisation.

Transversal:

3. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

TEACHING METHODOLOGY

Teaching methodology is a combination of lectures in the classroom and homeworks, along with a midterm and a final exam. Because of the situation occasioned by the pandemic, each student has to do an individual part that consists of self studying the notes and short videos of each of the subjects. The presential lectures will be devoted to solving problems and questions.

LEARNING OBJECTIVES OF THE SUBJECT

To present the fundamental concepts of differential and integral calculus of several variables, and linear algebra. To develop the ability to applying them to engineering problems.

STUDY LOAD

Type	Hours	Percentage
Hours large group	60,0	40.00
Self study	90,0	60.00

Total learning time: 150 h



CONTENTS

(ENG) Linear algebra and geometry

Description:

Vectors spaces. Linear combinations. Subspaces. Bases. Dimension. Linear mappings: definition and properties. Change of basis. Eigenvalues and eigenvectors. Characteristic polynomial. Diagonalization.

Specific objectives:

Identify and characterize vector spaces and subspaces, and manipulate vectors. Identify diagonalizable endomorphisms.

Full-or-part-time: 40h

Theory classes: 16h

Self study : 24h

(ENG) Functions of several variables

Description:

Vector-valued and scalar-valued functions. Topology. Limit and continuity. Directional and partial derivative. Differentiable functions, Jacobian matrix. Chain rule. Higher order derivative. Taylor's expansion theorem for functions of several variables.

Specific objectives:

Study of functions of several variables with emphasis on the concepts and methods of differential calculus of several variables.

Full-or-part-time: 30h

Theory classes: 12h

Self study : 18h

(ENG) -Extrema of real functions of several variable

Description:

Local and global extrema. Test for local extrema. Constrained extrema. Lagrange multiplier method.

Specific objectives:

To acquire the basic tools for analyzing extrema problems, both free and constrained extrema problems.

Full-or-part-time: 15h

Theory classes: 6h

Self study : 9h

(ENG) -Multiple integration and applications

Description:

Double integral: definition and properties. Change of variables for double integrals. Triple integral: definition and properties. Change of variables for triple integrals. Applications for the double and triple integral: volume computations, center of mass and moments of inertia.

Specific objectives:

Ability for solving problems of multiple integration and its application to problems of science and engineering.

Full-or-part-time: 30h

Theory classes: 12h

Self study : 18h



(ENG) Differential geometry and field theory

Description:

Parametrized curves. Vector fields and scalar fields. Operators: gradient, divergence and curl. Conservative vector field and its associated potential function. Line integral. Green's theorem. Surface integral. Divergence and Stoke's theorems.

Specific objectives:

Ability to provide analytical descriptions of curves and surfaces, calculate their properties and perform differential and integral calculus operations on them. Applications in field theory.

Full-or-part-time: 35h

Theory classes: 14h

Self study : 21h

GRADING SYSTEM

The grading will be carried out by means of the assessment by the teacher. The students should pass the subject with the continuous assessment based on the controls and the realization of exercises that will be common for all students.

Examens:

Exam 1 (25%) (Test plus a problem)

Exam 2 (17%) (Test plus a problem)

Exam 3 (23%) (Test plus a problem)

Exam 4 (35%) (Test plus two problems)

The subject DOES NOT HAVE a resit test .

It is recommended to consult the general regulation of evaluation of the EEBE

(<https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf/view>)

EXAMINATION RULES.

During the exams, the use of calculators, mobiles, PC's or tablets is not allowed, except for Exam 2. For the remaining exams, the students will be provided with a form that will be the only material that can be used during exams.

BIBLIOGRAPHY

Basic:

- Dineen, S. Multivariate calculus and geometry. 2nd ed. London [etc.]: Springer, 2001. ISBN 185233472X.
- Larson, R.; Hostetler, R. P.; Edwards, B. H. Cálculo [on line]. 9ª ed. Madrid [etc.]: McGraw-Hill, 2010 [Consultation: 29/04/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5686. ISBN 9781456239565.
- Grossman, S. I. Álgebra lineal [on line]. 7ª ed. México D.F. [etc.]: Mc Graw-Hill, cop. 2012 [Consultation: 29/04/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4369. ISBN 9781456219918.
- Zill, D. G.; Wright, W. S.; Cullen, M. R. Matemáticas avanzadas para ingeniería [on line]. 3ª ed. México [etc.]: McGraw-Hill, cop. 2008 [Consultation: 29/04/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4315. ISBN 9781456219864.
- Rogawski, J. Cálculo. 2a ed. Barcelona [etc.]: Reverté, cop. 2012. ISBN 9788429151664.
- Marsden, J. E; Tromba, A. Vector calculus. 6th ed. New York: Freeman and Co., cop. 2012. ISBN 9781429224048.
- Marsden, J. E.; Tromba, A. J. Cálculo vectorial. 5ª ed. Madrid: Addison Wesley, 2004. ISBN 8478290699.
- Arias, I. Cálculo avanzado para ingeniería : teoría, problemas resueltos y aplicaciones [on line]. Barcelona: Edicions UPC, 2008 [Consultation: 14/04/2020]. Available on: <http://upcommons.upc.edu/l1ibres/handle/2099.3/36849>. ISBN 9788483017609.

Complementary:

- Kreyszig, E. Matemáticas avanzadas para ingeniería. 3a ed.. México, D.F. [etc.]: Limusa, 2000. ISBN 9681853105.
- Castellet, M.; Llerena, I. Álgebra lineal i geometria [on line]. Bellaterra: Universitat Autònoma de Barcelona. Servei de Publicacions,



1991 [Consultation: 15/05/2020]. Available on:
http://www.ingebook.com/recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=8585. ISBN
9788429150094.

- Alsina, C.; Trillas, E. Lecciones de álgebra y geometría : curso para estudiantes de arquitectura. 2ª ed. Barcelona: Gustavo Gili,
1984. ISBN 8425211875.