Course guide
820008 - ACM - Algebra and Multivariable Calculus

Last modified: 02/10/2025

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

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

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: FAYÇAL IKHOUANE EL MOUSTACHIR - ANA BELEN DE FELIPE PARAMIO

Others: Primer quadrimestre:
ANGELES CARMONA MEJIAS - Grup: M1
ANA MARÍA CORTÉS HINOJOSA - Grup: M2
ANA BELEN DE FELIPE PARAMIO - Grup: M3
FAYÇAL IKHOUANE EL MOUSTACHIR - Grup: T1, Grup: T2

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

The subject uses the expository methodology and individual work where the student prepares for the partial evaluation tests. Part of the dedication to the subject consists of the individual study of the class notes with the support of short videos. The sessions consist of a review of theoretical concepts and the resolution of problems and doubts.

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 an assessment by the teacher. Students who are to pass the subject need to take the continuous assessment based on exams that are common to all students. There are three exams
- A partial exam (PE) (40%) approximately in week 11
- An exam to assess the generic competency (GC) (15%) approximately in week 8
- A final exam (FE) (45%)

According to the general evaluation regulations, in case the final grade FG = PE * 0.40 + GC * 0.15 + FE * 0.45 is lower than 5, there is a Resit test (RT). This exam assesses the entire subject except the generic competency. Only students with an PE * 0.40 + FE * 0.45 grade above or equal to 2.55 may apply.
In this case the final grade is min(max (RT*0.85 + GC*0.15, FG), 5).
It is recommended to consult the general evaluation regulations of the EEBE.

EXAMINATION RULES.

All exams are face-to-face

BIBLIOGRAPHY

Basic:
- 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/llibres/handle/2099.3/36849. ISBN 9788483017609.
- 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.
- Marsden, J. E; Tromba, A. Vector calculus. 6th ed. New York: Freeman and Co., cop. 2012. ISBN 9781429224048.
- Rogawski, J. Cálculo. 2a ed. Barcelona [etc.]: Reverté, cop. 2012. ISBN 9788429151664.
- 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.

Complementary:
- Kreyszig, E. Matemáticas avanzadas para ingeniería. 3a ed.. México, D.F. [etc.]: Limusa, 2000. ISBN 9681853105.
- Castellet, M.; Llerena, I. Àlgebra 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.