

Course guide 340026 - CAAV-F2O43 - Advanced Calculus

Last modified: 08/07/2024

Unit in charge: Teaching unit:	Vilanova i la Geltrú School of Engineering 749 - MAT - Department of Mathematics.
Degree:	 BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject). BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Optional 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).
Academic year: 2024	ECTS Credits: 6.0 Languages: Catalan

LECTURER	
Coordinating lecturer:	Prat Farran, Joana D'Arc
Others:	Sanchez Campoy, Miguel Prat Farran, Joana d'Arc

PRIOR SKILLS

- Mastering the basic tools of differential and integral calculus of real functions in one real variable.

- Knowledge how to operate with complex numbers.

- Understanding of the factorization of polynomials with real or complex coefficients.

- Knowledge of the basic tools of linear algebra.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. CE1. Ability to solve arithmetic problems related to engineering. Aptitude to apply knowledge concerning: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimization.

TEACHING METHODOLOGY

The theoretical foundations of the subject will be taught to the large groups, if necessary with the help of media, such as transparencies, video or computer-assisted simulations.

At the beginning of each content will be given a list of representative problems, the numerical solution if necessary, to serve as motivation for students to realize them.

Also will be proposed problems that require the use of a computer medium.

LEARNING OBJECTIVES OF THE SUBJECT

The general objectives to get from the students at the end of the course are:

o Understand and apply, if necessary using specific software, the basic techniques of differential calculus of several variables and integral calculus of several variables.

o Understand and apply, if necessary using specific software, integration of scalar and vector fields on curved surfaces, as well as the integral theorems of Gauss and Stokes.



STUDY LOAD

Туре	Hours	Percentage
Hours large group	52,5	35.00
Self study	90,0	60.00
Hours small group	7,5	5.00

Total learning time: 150 h

CONTENTS

1- Differential multivariable calculus

Description:

1.1 Conics and Quadrics1.2 Scalar functions of two variables

1.3 Partial derivatives and directional derivatives. Tangent plane and normal vector

Related activities:

Activity 1: Problems and exercises using specific software Activity 2: Test of contents 1 and 2 Activity 3: Test of contents 1, 2, 3 and 4

Full-or-part-time: 36h Theory classes: 9h Practical classes: 6h Self study : 21h

2- Multiple Integral

Description:

2.1 Double Integral. Change to polar coordinate2.2 Triple Integral. Changes in cylindrical and spherical coordinates

Related activities:

Activity 1: Problems and exercises using specific software Activity 2: Test of contents 1 and 2 Activity 3: Test of contents 1, 2, 3 and 4

Full-or-part-time: 36h

Theory classes: 9h Practical classes: 6h Self study : 21h



3- Integral multivariable calculus

Description:

- 3.1 Vector functions of several variables. differential operators
- 3.2 Curves and Surfaces. Parameterization
- 3.3 Line integral
- 3.4 Surface integral

Related activities:

Activity 1: Problems and exercises using specific software Activity 3: Test of contents 1, 2, 3 and 4

Full-or-part-time: 42h Theory classes: 11h Practical classes: 6h Self study : 25h

4- Integral theorems

Description:

4.1 Stokes Theorem4.2 Conservative Fields4.3 Divergence Theorem

Related activities:

Activity 1: Problems and exercises using specific software Activity 3: Test of contents 1, 2, 3 and 4 $\,$

Full-or-part-time: 30h Theory classes: 7h Practical classes: 6h Self study : 17h

ACTIVITIES

1- PROBLEMS AND EXERCISES BY SPECIFIC SOFTWARE

Description:

It consists of the resolution by the student of exercises and/or problems made through specific software. Students will present the results and eventually explain how they have obtained them.

Specific objectives:

The student must be able to:

o View scalar functions in two variables, their level curves and tangent lines.

o Parametrize and visualize conics and quadrics.

o Know the parametrisation concept and how to use it to represent curves and surfaces.

Material:

List of problems and templates in digital format to perform problems.

Delivery:

In digital and/or written format. They count 30% of the final grade.

Full-or-part-time: 16h Laboratory classes: 4h Self study: 12h



2 - EXAM OF CONTENTS 1 AND 2

Description:

It consists of the completion by the student of an individual written test of contents 1 and 2.

Specific objectives:

The student must be able to solve problems related to contents 1 and 2.

Material:

Statement of the test.

Delivery: In writing. It counts for 20% of the final grade.

Full-or-part-time: 2h

Guided activities: 2h

3 - EXAM OF CONTENTS 1, 2, 3 AND 4

Description:

It consists of the completion by the student of an individual written test of all the contents.

Specific objectives: The student must be able to solve problems related to contents 1, 2, 3 and 4.

Material: Statement of the exam.

Delivery: In writing. It counts 50% or 70% of the final grade.

Full-or-part-time: 3h Guided activities: 3h

GRADING SYSTEM

The course evaluation will be with the activities 1, 2 and 3. o Activity 1 (A1). Problems and exercises using specific software. o Activity 2 (A2). Exam of Content until the week of partial exams. o Activity 3 (A3). Exam of all Content.

FINAL GRADE = 0.3*A1+ MAX (0.2*A2+0.5*A3, 0.7*A3)

Activity A3 is the only re-gradable activity.

EXAMINATION RULES.

In no case can it be copied or allowed to be copied; Failure to comply with this rule in any of the activities will result in a 0 in the grade for the corresponding activity or in the final grade.

The particular regulations of the activities will be announced in each case with enough time.

All activities are individual.

Activity 2 will be carried out in the week reserved for the first testing period of the course, which appears in the EPSEVG Academic Calendar.

Activity 3 will be carried out in the final evaluation period that appears in the EPSEVG Academic Calendar.



BIBLIOGRAPHY

Basic:

Antonijuan, Josefina [et. al.]. Funcions de diverses variables : curs bàsic. 2a ed. Barcelona: Edicions UPC, 2000. ISBN 8483014130.
 Antonijuan, Josefina; Batlle, Carles; Boza, Santiago; Prat, Joana d'Arc. Matemàtiques de la telecomunicació [on line]. Barcelona: Edicions UPC, 2001 [Consultation: 04/04/2022]. Available on: https://upcommons.upc.edu/handle/2099.3/36249. ISBN 8483015757.
 Larson, Ron [et al.]. Cálculo. Vol. 2 [on line]. 10a ed. México: Cengage Learning, 2016 [Consultation: 13/09/2024]. Available on: https://www.ingebook.com/ib/NPcd/IB BooksVis?cod primaria=1000187&codigo libro=5686. ISBN 9786075220178.

- Marsden, Jerrold E.; Tromba, Anthony J. Cálculo vectorial [on line]. 6a ed. Madrid: Pearson, 2018 [Consultation: 19/02/2024]. A vailable on:

https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=7634. ISBN 9788490355787.

RESOURCES

Hyperlink:

- "3D CALC PLOTTER" de Paul Seeburger de Brighton Campus

http://web.monroecc.edu/manila/webfiles/calcNSF/JavaCode/CalcPlot3D.htm.

Aplicació interactiva que permet visualitzar:

- funcions escalars de dues variables, les seves derivades parcials i direccionals i les corresponents rectes tangents, les corbes de nivell i el vector gradient,

-corbes i superfícies parametritzades.

- "CALCULUS APPLETS AT SLU" del Dept. of Mathematics and Computer Science of Saint Louis University

 $\underline{http://www.slu.edu/classes/maymk/MathApplets-SLU.html \# Understanding \ surfaces \ and \ graphs \ of.$

Col.lecció d'aplicacions interactives per al Càlcul de diverses variables, de les quals destaquem:

- visualització de funcions escalars de dues variables, corbes de nivell i seccions,

- visualització de corbes i superfícies,

- visualització i càlcul d'integrals de línia,

- visualització i càlcul d'integrals de superfície.