

## 300203 - CAL-A - Calculus (Aeronautical Engineering)

Coordinating unit:	300 - EETAC - Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit:	749 - MAT - Department of Mathematics
Academic year:	2018
Degree:	BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING (Syllabus 2015). (Teaching unit Compulsory) BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERINGS/BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING - NETWORK ENGINEERING (AGRUPACIÓ DE SIMULTANEÏTAT) (Syllabus 2015). (Teaching unit Compulsory) BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING/BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2015). (Teaching unit Compulsory) BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING/BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)
ECTS credits:	6
Teaching languages:	Catalan, Spanish

### Teaching staff

Coordinator:	Definit a la infoweb de l'assignatura.
Others:	Definit a la infoweb de l'assignatura.

### Prior skills

Upper secondary school mathematics.  
The ability to work with abstract concepts.  
Familiarity with the concept of a function and the graphic representation of a function.  
The ability to perform mathematical calculations, simplifications of algebraic expressions and calculus of elementary functions of one variable.  
Basic understanding of geometry.

### Degree competences to which the subject contributes

Specific:

1. CE 1 AERO. Capacidad para la resolución de los problemas matemáticos que puedan plantearse en la ingeniería. Aptitud para aplicar los conocimientos sobre: álgebra lineal; geometría; geometría diferencial; cálculo diferencial e integral; ecuaciones diferenciales y en derivadas parciales; métodos numéricos; algorítmica numérica; estadística y optimización. (CIN/308/2009, BOE 18.2.2009)

Transversal:

2. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
3. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

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### Teaching methodology

Large group sessions are used to introduce the basic concepts covered in the subject and to present basic techniques for completing exercises and solving specific problems. Medium-sized group sessions are used for discussion of the exercises and problems set by the teaching staff. Specific software will be used in some sessions. Sessions reserved for directed activities will be used to clarify doubts concerning the exercises and problems set by the teaching staff, which students must prepare in writing prior to each session, working individually or in pairs. In some cases students will be asked to present their solutions to the rest of the class, discuss their work with the teaching staff (during class or in tutorial hours) or submit their solutions in writing.

### Learning objectives of the subject

On completion of Calculus, students will be able to:

- Entendre el concepte de límit d'una funció en un punt i conèixer algunes tècniques per calcular-ne.
- Entendre i saber interpretar físicament i geomètrica el concepte de derivada d'una funció d'una variable.
- Tenir destresa en el càlcul de derivades de funcions.
- Conèixer la fórmula de Taylor i la seva aplicació a l'estudi local de funcions.
- Entendre el concepte d'integral i calcular àrees de regions planes i volums d'alguns sòlids a l'espai.
- Conèixer algunes tècniques de càlcul de primitives.
- Identificar les còniques i quàdriques a partir de les seves equacions.
- Adquirir destresa en càlculs que involucrin corbes i superfícies.
- Entendre i saber interpretar geomètricament els conceptes de derivada direccional, diferencial i gradient.
- Calcular extrems locals i absoluts de funcions d'una i de diverses variables, incloent-hi alguns casos d'extrems condicionats.

### Study load

Total learning time: 150h	Hours large group:	39h	26.00%
	Hours medium group:	13h	8.67%
	Hours small group:	0h	0.00%
	Guided activities:	14h	9.33%
	Self study:	84h	56.00%

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### Content

<p>Functions</p>	<p>Learning time: 14h Theory classes: 3h Practical classes: 1h Guided activities: 2h Self study : 8h</p>
<p>Description: Functions of one variable. Limit of a function at a given point; Continuity. Conics.</p> <p>Related activities: Test 1 and Activity 3</p>	
<p>Derivation</p>	<p>Learning time: 33h Theory classes: 9h Practical classes: 3h Guided activities: 3h Self study : 18h</p>
<p>Description: Concept of derivative of a function at a given point. Implicit derivation; Geometric problems (angles, tangency, perpendicularity). Indeterminacy; L'Hôpital's rule. Taylor polynomials. Relative and absolute extrema of functions of one variable.</p> <p>Related activities: Test 1 and Activity 4</p>	
<p>Integration</p>	<p>Learning time: 33h Theory classes: 9h Practical classes: 3h Guided activities: 3h Self study : 18h</p>
<p>Description: Calculating primitives. Definite integral of a function of one variable. Applications: Areas of plane regions, volumes of solids of revolution. Improper integrals.</p> <p>Related activities: Test 2 and Activity 4</p>	

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Functions of Several Variables	Learning time: 26h Theory classes: 7h Practical classes: 2h Guided activities: 2h Self study : 15h
<p>Description: Scalar and vector functions of several variables. Level sets and graphs. Curves and surfaces; Quadrics. Parametric curves; Tangent vector; Curvature.</p> <p>Related activities: Test 2 and Activity 5</p>	
Differential Calculus of Several Variables	Learning time: 44h Theory classes: 11h Practical classes: 4h Guided activities: 4h Self study : 25h
<p>Description: Partial and directional derivatives. Concept of differential at a point: Tangency condition. Gradient. Absolute and conditional extrema; Calculus using parameterisation and Lagrange multipliers.</p> <p>Related activities: Activity 5</p>	

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### Planning of activities

TEST 1	Hours: 5h 30m Guided activities: 1h 30m Self study: 4h
<p>Description: Test at the beginning of Topic 2.</p> <p>Support materials: No materials are required.</p> <p>Descriptions of the assignments due and their relation to the assessment: Proportion of final mark: 15%</p> <p>Specific objectives: To assess students' grasp of the basic concepts and provide general guidance on completing the subject.</p>	
TEST 2	Hours: 7h 30m Guided activities: 1h 30m Practical classes: 6h
<p>Description: Test of Topics 3 and 4.</p> <p>Support materials: No materials are required.</p> <p>Descriptions of the assignments due and their relation to the assessment: Proportion of final mark: 15%</p> <p>Specific objectives: To assess students' knowledge of the calculation and application of some primitives, and of multi-variable functions.</p>	
ACTIVITY 4: DOUBTS AND QUERIES AND INTRODUCTORY EXERCISES	Hours: 5h Guided activities: 1h Self study: 4h
<p>Description: Students must present a specific query on the content of Topic 1 for discussion in class. This exercise will help the group to structure their ideas and clarify ideas they have not assimilated fully. Given the range of academic backgrounds in the group, the exercise will also give the lecturer valuable feedback on the degree to which students have understood the content of Topic 1.</p> <p>Support materials: Individual class notes.</p> <p>Descriptions of the assignments due and their relation to the assessment: This activity counts for 1% of the overall mark. Students will submit at least two exercises for assessment. This activity counts for 1% of the overall mark. Students will submit at least two exercises for assessment.</p> <p>Specific objectives: To develop effective spoken communication, learn to raise doubts and queries clearly and accurately, and become familiar with mathematical terminology.</p>	

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<b>ACTIVITY 5: EXERCISES AND PROBLEMS ON DERIVATION AND INTEGRATION</b>	Hours: 17h Guided activities: 5h Self study: 12h
<p><b>Description:</b> Students will complete basic exercises and solve some more advanced problems on the derivation and integration of functions of one variable, dealing particularly with implicit derivation, Taylor's formula, calculation of primitives and applications of the integral. Students will complete some exercises individually and some in pairs. Each problem will be discussed with the rest of the class. In some cases, students will submit written exercises to be corrected and returned by the teaching staff.</p> <p><b>Support materials:</b> List of exercises.</p> <p><b>Descriptions of the assignments due and their relation to the assessment:</b> This activity counts for 2% of the overall mark. Students will submit at least two exercises for assessment. This activity counts for 2% of the overall mark. Students will submit at least two exercises for assessment.</p> <p><b>Specific objectives:</b> Effective spoken and (most importantly) written communication, paying particular attention to the correct use of mathematical terminology.</p>	

<b>ACTIVITY 6: EXERCISES AND PROBLEMS ON FUNCTIONS OF SEVERAL VARIABLES</b>	Hours: 17h Guided activities: 5h Self study: 12h
<p><b>Description:</b> Students will complete basic exercises and solve some more advanced problems on functions of several variables, dealing particularly with level sets and extrema (local, absolute and conditional). Students will complete some exercises individually and some in pairs. Each problem will be discussed with the rest of the class. In some cases, students will submit written exercises to be corrected and returned by the lecturer.</p> <p><b>Descriptions of the assignments due and their relation to the assessment:</b> This activity counts for 2% of the overall mark. Students will submit at least two exercises for assessment.</p> <p><b>Specific objectives:</b> Effective spoken and (most importantly) written communication, paying particular attention to the correct use of mathematical terminology.</p>	

### Qualification system

The evaluation criteria are available at the infoweb space

### Regulations for carrying out activities

All the evaluation activities are mandatory. They must be done individually.

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### Bibliography

#### Basic:

Larson, Ron; Edwards, Bruce H.; Ibarra Escutia, Joel. Cálculo. Vol. 1, Cálculo 1, de una variable. 9a. México [etc.]: McGraw-Hill, 2010. ISBN 9786071502735.

"Diferenciación". Marsden, Jerrold E.; Tromba, Anthony. Cálculo vectorial. Madrid [etc.]: Addison Wesley, 2004. P. 75-188.

"Funciones con valores vectoriales". Marsden, Jerrold E.; Tromba, Anthony. Cálculo vectorial. Madrid [etc.]: Addison Wesley, 2004. P. 189-240.

Larson, Ron; Edwards, Bruce H.; Ibarra Escutia, Joel. Cálculo. Vol. 2, Cálculo 2, de varias variables. 9a. México [etc.]: McGraw-Hill, 2010. ISBN 9789701071342.

#### Complementary:

Salas, Saturnino L.; Hille, Einar; Etgen, Garret J. Calculus : una y varias variables. 4<sup>a</sup>. Barcelona [etc.]: Reverté, 2002. ISBN 9788429151565.

Barrière, Lali. Fonaments matemàtics per a l'enginyeria de telecomunicació. Barcelona: Edicions UPC, 2007. ISBN 9788483019078.