300200 - AG - Algebra and Geometry

Coordinating unit: 300 - EETAC - Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING/BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING - NETWORK ENGINEERING (AGRUPACIÓ DE SIMULTANEITAT) (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.

Opening hours
Timetable: Available in the EETAC infoweb

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.

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.

Teaching methodology
In the theory sessions, fundamental concepts of the subject will be introduced and the basic techniques will be presented for the solution of exercises and problems.

In the problem-solving sessions, problems proposed a priori by the faculty and prepared by the students autonomously will be discussed and solved.
300200 - AG - Algebra and Geometry

Learning objectives of the subject

On completion of Algebra and Geometry, students will be able to:
- carry out operations with complex numbers in binomial and exponential form (Euler's formula) and apply the fundamental theorem of algebra to polynomial root calculation;
- solve linear equation systems;
- carry out operations with matrices;
- enumerate and apply the properties of vector spaces;
- characterise linear applications, apply changes of basis and diagonalise matrices;
- geometrically interpret and solve the most common first-order differential equations, linear differential equations of order n and systems of first-order linear differential equations with constant coefficients, and find specific solutions;
- define the Laplace transform and its main properties;
- calculate the Laplace transform of common functions and the inverse transform of rational functions by partial fraction decomposition and using the convolution theorem;
- apply the Laplace transform to initial value problems and solve initial value problems with general functions (Dirac delta) and continuous piecewise functions.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 39h</th>
<th>26.00%</th>
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<td>Hours medium group: 12h</td>
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<td>Guided activities: 15h</td>
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<td>Self study: 84h</td>
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### Content

#### Content 1: Complex Numbers

**Description:**
1.1 Binomial, polar and exponential forms; Operations: Sum, product, quotient, powers, roots of unity.
1.2 Fundamental theorem of algebra and polynomial decomposition.

**Related activities:**
Test C1, Mid term exam and Final term exam.

**Learning time:** 14h 10m  
Theory classes: 3h 30m  
Practical classes: 1h  
Guided activities: 1h 20m  
Self study: 8h 20m

#### Content 2: Linear Systems, Matrices and Determinants

**Description:**
2.1 Matrices; Operations with matrices; Inverse matrices; Rank; Gauss method.
2.2 Determinants.
2.3 Linear equation systems; Discussion and solution of systems; Cramer's rule; The superposition principle.

**Related activities:**
Test C1, Mid term exam and Final term exam.

**Learning time:** 15h 30m  
Theory classes: 3h 20m  
Practical classes: 1h  
Guided activities: 1h 20m  
Self study: 9h 50m

#### Content 3: Linear spaces

**Description:**
3.1 Vector spaces and subspaces; Subspace generated by a set: Linear combinations; Linear dependence and independence; Generator systems.
3.2 Bases; Dimension; Coordinates of a vector basis; Change of basis.
3.3 Operations with subspaces. Direct sum.

**Related activities:**
Test C1, Mid term exam and Final term exam.

**Learning time:** 17h 05m  
Theory classes: 4h 55m  
Practical classes: 1h  
Guided activities: 1h 20m  
Self study: 9h 50m
### Content 4: Linear mappings. Diagonalisation.  
#### Description:
4.1 Definitions and properties; Kernel and image; Matrix of a linear application; Change of basis in linear applications.
4.2 Diagonalisable endomorphisms and matrices; Eigenvectors and eigenvalues; Characteristic polynomial.
4.3 Diagonalisation; First decomposition theorem.
#### Related activities:
Mid term exam and Final exam.

### Content 5: Differential Equations
#### Description:
5.1 First-order differential equations; Definition; Separable, linear and homogeneous equations.
5.2 Higher-order linear differential equations with constant coefficients; Test method for obtaining a specific solution in the inhomogeneous case.
5.3 Systems of linear differential equations with constant coefficients.
#### Related activities:
Test C2 and Finalexam.

### Content 6: Laplace Transform
#### Description:
6.1 The Laplace transform; Definition; Properties; Inverse of a rational function; Application to initial value problem solving; Heaviside function; Laplace transform of piecewise functions; General functions; Dirac delta; Impulse response and transfer function; Convolution theorem.
6.2 Use of the Laplace Transform to solve linear differential systems of equations with constant coefficients.
#### Related activities:
Final exam.
### Planning of activities

| Activity 1: Test C1 | Hours: 10h 45m  
Theory classes: 0h 45m  
Practical classes: 0h  
Laboratory classes: 0h  
Guided activities: 0h  
Self study: 10h |
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<td>Description:</td>
<td>Test on contents 1, 2 and 3.</td>
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| Activity 2: Test C2 | Hours: 10h 45m  
Theory classes: 0h 45m  
Practical classes: 0h  
Laboratory classes: 0h  
Guided activities: 0h  
Self study: 10h |
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| Activity 3: Mid term exam | Hours: 3h  
Theory classes: 0h  
Practical classes: 0h  
Laboratory classes: 0h  
Guided activities: 1h 30m  
Self study: 1h 30m |
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| Activity 4: Final exam    | Hours: 8h  
Theory classes: 0h  
Practical classes: 0h  
Laboratory classes: 0h  
Guided activities: 2h  
Self study: 6h |
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<td>Description:</td>
<td>Examen on contents 1, 2, 3, 4, 5 and 6.</td>
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### Descriptions of the assignments due and their relation to the assessment:
Qualification system

Available in the subject's infoweb

Regulations for carrying out activities

Tests are done in class hours and on dates announced in advance in ATENEA. Mid term and final exams are done on the dates scheduled by the EETAC.

Exams and tests are done individually. Books, notes, calculators, computer equipment and mobile phones are not allowed.

Bibliography

Basic:


Complementary:


Others resources:

Material available on the digital campus (Atenea):
- Lists of example problems.
- Course notes.
- Question sheets for directed activities.

Web link about ordinary differential equations:
http://canek.uam.mx/index ?secc=8