Course guide
820007 - CAL - Calculus

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: 2023  ECTS Credits: 6.0  Languages: Catalan, Spanish, English

LECTURER

Coordinating lecturer:
- Pozo Montero, Francesc
- Pares Marine, Nuria
- Vidal Segui, Yolanda

Others:
- Primer quadrimestre:
  - ENRIC AMADO VICENTE - Grup: T21, Grup: T22
  - ANGELES CARMONA MEJIAS - Grup: M51, Grup: M52, Grup: M62
  - RAIMON ELGUETA MONTO - Grup: M82, Grup: T11
  - ALFONSO ESCOBOSA FERNANDEZ - Grup: T11, Grup: T12
  - PERE LOPEZ BROSAS - Grup: M21, Grup: M32, Grup: M72, Grup: X21
  - ALBERT MAS BLESA - Grup: M31, Grup: M32, Grup: M51, Grup: M52, Grup: M81, Grup: X11
  - NURIA PARES MARINE - Grup: M11, Grup: M31, Grup: M42
  - JOAN QUINTANA COMPTE - Grup: M71, Grup: M91, Grup: M92
  - MIGUEL ANDRES RODRIGUEZ OLMOS - Grup: M61, Grup: M62, Grup: M81, Grup: M82, Grup: X11, Grup: X12
  - MAGDA LILIANA RUIZ ORDOÑEZ - Grup: M41, Grup: M61

PRIOR SKILLS

This course requires no previous skills.

REQUIREMENTS

This course has no prerequisites.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONtributes

Specific:
- 2. 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:
- 1. 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 course uses the expositive methodology by 40% and individual work by 60%.

LEARNING OBJECTIVES OF THE SUBJECT

General objectives: Students will learn the fundamental concepts of single variable calculus, developing the capacity of abstraction and applying these techniques to mathematical problems encountered in engineering.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>10.00</td>
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<tr>
<td>Hours large group</td>
<td>45,0</td>
<td>30.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

Sets of numbers

Description:
- The set of real numbers: Supremum axiom.

Specific objectives:
The students will learn:
- Supremum axiom, key to understand the completeness of real numbers.
- to operate with complex numbers.
- to establish relationships between binomial, polar, and exponentials forms.

Related activities:
Lab session 1. Conics
Lab session 2. Complex numbers

Full-or-part-time: 30h
Theory classes: 8h
Laboratory classes: 4h
Self study: 18h
Functions of real variable. Limits and continuity.

**Description:**
- Composition of functions. Inverse function.
- Continuity. Continuity theorems (Weierstrass, Bolzano, intermediate value theorem).

**Specific objectives:**
Students will learn:
- to represent a real-valued function.
- to understand the importance of the concept of limit and its relationship to continuity.

**Related activities:**
Lab Session 3. Limits and continuity

**Full-or-part-time:** 30h
Theory classes: 10h
Laboratory classes: 2h
Self study : 18h

Differentiation of real-valued functions

**Description:**
- Mean value theorems (Rolle, Cauchy, Lagrange).
- Extrema of a function in an interval.

**Specific objectives:**
The student will learn:
- the basic concepts of differentiation.
- to understand the geometric interpretation of the derivative and its applications in engineering.
- to master and apply the elementary properties of the differentiable functions.
- to master the computation of derivatives, both analytically and with the help of mathematical software.
- to model and solve several problems by computing derivatives: optimization, approximation of functions, and qualitative study of functions.

**Related activities:**
Lab session 6. PART I: Taylor polynomial

**Full-or-part-time:** 35h
Theory classes: 12h
Laboratory classes: 2h
Self study : 21h
Integration of real-value functions

Description:
- Primitive functions.
- Integration methods: direct methods, change of variable, integration by parts, trigonometric integrals.
- Computation of areas of plane regions. Applications.
- Improper integrals.

Specific objectives:
Students will learn:
- to express in terms of integrals the problem of computing the area of a plane region.
- to understand the relationship between derivatives and integrals, given by the fundamental theorem of calculus.
- to use the Barrow's rule.
- to compute some improper integrals of continuous functions on an unbounded interval, and improper integrals of functions with a singularity inside a bounded interval.

Related activities:
Lab session 6. PART II: Integration
Lab session 7. Lab session exam (10%)
**GRADING SYSTEM**

First partial exam: 35%
Second partial exam: 45%
Laboratory exam (Maple): 10%
Generic competence: 10%

Students can pass the course through the continuous assessment based on two exams (a first mid-course exam and a second exam during the period fixed in the academic calendar of the school devoted to the final exams) and the delivery of laboratory assessments. This subject does not have a reevaluation test.

An individual test will be performed in the assessment of the laboratory, during the last laboratory session, and another test will evaluate the generic competency. This course assesses the self-directed learning competency through individual tests during the development of one of the laboratory sessions. More precisely, the test will assess conic sections.

**EXAMINATION RULES.**

No material can be consulted (neither printed papers, books, nor handwritten notes) nor any type of mobile, tablets or any electronic device can be used, except for a scientific calculator.

**BIBLIOGRAPHY**

**Basic:**

**Complementary:**

**RESOURCES**

**Hyperlink:**
- Khan Academy. Resource

**Other resources:**
Web page: https://es.khanacademy.org