820007 - CAL - Calculus

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics

Academic year: 2019

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

ECTS credits: 6

Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: ANGELES CARMONA MEJIAS - MAGDA LILIANA RUIZ ORDOÑEZ

Others: Primer quadrimestre:
MERCE CLAVEROL AGUAS - M52, M61, M62, M81, M82, T11, T91, T92
RAIMON ELGUETA MONTO - M71, M72
SERGIO GONZÁLEZ LÓPEZ - M51, M52, T12, T91, T92
M. JOSÉ JIMÉNEZ JIMÉNEZ - T21, T22, T31, T32, T81, T82
ALVARO MARTIN LLOPIS - T31, T32
ALBERT MAS BLESA - M21, M22, M31, M32, T81
MARGARIDA MITJANA RIERA - M71, M72, T82
NURIA PARES MARINE - M11, M12, M31, M32
FRANCESC POZO MONTERO - M11, M12
JUAN TRIAS PAIRO - M41, M42, M51, M61, M62

Opening hours

Timetable: Reach your teacher by e-mail for a more detailed information.

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>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>45h</th>
<th>30.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group:</td>
<td>15h</td>
<td>10.00%</td>
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<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
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</tbody>
</table>
## Content

### Sets of numbers

<table>
<thead>
<tr>
<th>Learning time: 30h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 8h</td>
</tr>
<tr>
<td>Practical classes: 0h</td>
</tr>
<tr>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>Self study: 18h</td>
</tr>
</tbody>
</table>

**Description:**
- The set of real numbers: Supreme axiom.

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

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

### Functions of real variable. Limits and continuity

<table>
<thead>
<tr>
<th>Learning time: 30h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 10h</td>
</tr>
<tr>
<td>Practical classes: 0h</td>
</tr>
<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Self study: 18h</td>
</tr>
</tbody>
</table>

**Description:**
- Continuity. Continuity theorems (Weierstrass, Bolzano, intermediate value theorem).

**Related activities:**
- Lab Session 3. Limits and Continuity

**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.
### Differentiation of real valued functions

**Learning time:** 35h  
Theory classes: 12h  
Practical classes: 0h  
Laboratory classes: 2h  
Self study: 21h

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

**Related activities:**  
Lab session 6. Taylor Polynomials

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

### Integration of functions of real variable

**Learning time:** 42h  
Theory classes: 13h  
Practical classes: 0h  
Laboratory classes: 3h  
Self study: 26h

**Description:**  
- Antiderivatives.  
- Integration methods: direct methods, change of variable, integration by parts, trigonometric integrals.  
- Calculation of areas of plane regions. Applications.  
- Improper integrals.

**Related activities:**  
Lab session 6. Integration  
Lab session 7. Lab session exam (10%)  
Lab session exam (10%)

**Specific objectives:**  
Students will learn:  
- to express in terms of integrals the problem of calculation 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 calculate some improper integrals of continuous functions on an unbounded interval.
First partial exam: 30%
Second partial exam: 50%
Laboratory: 10%
Generic competence (self-directed learning): 10%

The evaluation will be conducted through the assessment by the teacher.

The students can pass the course only by the assessment during the course from two partial exams (first partial exam within the course weeks; the second partial exam will be scheduled in the official final examination period), laboratory and the evaluation of generic competence.

An individual test will be performed in the assessment of the laboratory, during the last laboratory session.

Competence assessment: 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 conics.

Finally, as detailed in the academic normative of the EEBE, a reevaluation exam will take place (excluding the Maple Laboratory exam and the Generic Competence). To be able to do the reevaluation exam, the student has to fail and has to attend to all the evaluation exams of the subject and its mark, N, for the part which can be reevaluated has to be such that N > 3.0 (https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf).

**Linear algebra**

| Description: |
| Systems of linear equations. Gaussian elimination. |
| Inverse matrix. |
| Linear geometry: equation of a straight line and a plane; orthogonality and parallelism; distances. |

| Related activities: |
| Lab Session 4. Matrices |
| Lab Session 5. Generic competence assessment |

| Specific objectives: |
| Students will learn: |
| -to solve systems of linear equations and |
| -to graphically represent the solution of a system of linear equations |

**Learning time:** 15h
- Theory classes: 2h
- Practical classes: 0h
- Laboratory classes: 4h
- Self study: 9h

**Qualification system**

Linear algebra

Learning time:
- Theory classes: 2h
- Practical classes: 0h
- Laboratory classes: 4h
- Self study: 9h

Related activities:
- Lab Session 4. Matrices
- Lab Session 5. Generic competence assessment

Specific objectives:
- Students will learn:
  - to solve systems of linear equations and
  - to graphically represent the solution of a system of linear equations
Regulations for carrying out activities

No writing paper, books, papers, manuscripts or notes of any kind are to be taken into an examination room. The use of calculators, cell phones, tablets or any electronic device is not permitted in examinations.

Bibliography

Basic:


Complementary:


Others resources:

Web page: https://es.khanacademy.org

Hyperlink

Khan Academy

Resource