820009 - CNED - Numerical Calculus. Differential Equations

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN MECHANICAL 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 ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory) BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN ENERGY 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 MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory) BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (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

Teaching staff
Coordinator: JOSE JAVIER MUÑOZ ROMERO - M. JOSÉ JIMÉNEZ JIMÉNEZ
Others: Primer quadrimestre:
RAIMON ELGUETA MONTO - T11, T12, T21, T22
JOSE JAVIER MUÑOZ ROMERO - M11, M12, M21, M22
NURIA PARES MARINE - M11, M21, M31
YOLANDA VIDAL SEGUI - M12, M22, M31, M32

Opening hours
Timetable: To be determined by the faculty at the beginning of the semester. The students will be attended in the Mathematics Department at EEBE.

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 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
Unit 1: Introduce the students to computer simulation explaining its capabilities, potential and limitations. Programming of basic numerical algorithms. Correct and judgeful use of basic numerical methods. Ability to chose the appropriate method for different engineering applications.

Unit 2: State, analyze and numerically and analytically solve ordinary differential equations. Physical interpretation of ode's.

Unit 3: Use of integral transforms in engineering applications.

Unit 4: State, analyze and numerically and analytically solve partial differential equations. Physical interpretation of pde's.

Learning objectives of the subject

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 45h</th>
<th>30.00%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group: 15h</td>
<td>10.00%</td>
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<td></td>
<td>Guided activities: 0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Self study: 90h</td>
<td>60.00%</td>
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Apart from the 6 hours per week in the classroom, self-study must last an average of 9 hours per week (40% of the total work at class and 60% of individual work).
# Content

## Unit 1: Basics of numerical calculus

**Learning time:** 67h 15m  
Theory classes: 18h  
Laboratory classes: 9h 30m  
Self study: 39h 45m

**Description:**  
1.1. Numbers and errors. Finite arithmetic storage. Absolute error, relative error, truncation error. Correct significant digits.  

## Unit 2: Ordinary differential equations

**Learning time:** 36h 15m  
Theory classes: 12h  
Laboratory classes: 2h 30m  
Self study: 21h 45m

**Description:**  
2.3. Linear differential equations of order 2 with constant coefficients. Undetermined coefficients method. Variation of constants method.

## Unit 3: Integral transforms and solution of ordinary differential equations

**Learning time:** 27h 45m  
Theory classes: 9h  
Laboratory classes: 1h 30m  
Self study: 17h 15m

**Description:**  
3.2. Fourier series.
### Unit 4: Partial differential equations

<table>
<thead>
<tr>
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<th>Learning time: 18h 45m</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 6h</td>
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<tr>
<td></td>
<td>Laboratory classes: 1h 30m</td>
</tr>
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<td></td>
<td>Self study: 11h 15m</td>
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</tbody>
</table>

#### Description:
- 4.1. Introduction to partial differential equations. Motivation.
- 4.2. Equations of mathematical physics. Boundary conditions.

### Qualification system

- First exam: 30%
- Second exam: 40%
- Matlab Laboratory: 25%
- Generic competence: 5%

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.

Finally, as detailed in the academic normative of the EEBE, a reevaluation exam will take place (excluding the Matlab Laboratory exam and the Generic Competence). To be able to do the reevaluation exam, the student 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 $3,0 \leq N < 5,0$ (https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf).

### Regulations for carrying out activities

In the two exams it will be allowed to use scientific calculators, but NEITHER PROGRAMMABLE NOR GRAPHING calculators.
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Bibliography

Basic:


Complementary:


