Course guide
820009 - CNED - Numerical Calculus. Differential Equations

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: 2022 ECTS Credits: 6.0 Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: M. JOSÉ JIMÉNEZ JIMÉNEZ - JOSE JAVIER MUÑÓZ ROMERO

Others:
- Primer quadrimestre:
  - ENRIC AMADO VICENTE - Grup: T11, Grup: T12
  - ADRIÀ DOMINGO GIMENEZ - Grup: T31, Grup: T32
  - RAIMON ELGUETA MONTO - Grup: T31, Grup: T32
  - ALFONSO ESCOBOSA FERNANDEZ - Grup: T31, Grup: T32
  - M. JOSÉ JIMÉNEZ JIMÉNEZ - Grup: M11, Grup: M12, Grup: M21, Grup: M22
  - ALVARO MARTIN LLOPIS - Grup: T11, Grup: T12, Grup: T21, Grup: T22
  - NURIA PARES MARINE - Grup: M11, Grup: M12, Grup: M21, Grup: M22
  - MARGARITA TORRE ALCOCEBA - Grup: T21, Grup: T22, Grup: T31, Grup: T32

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.

TEACHING METHODOLOGY

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).

LEARNING OBJECTIVES OF THE SUBJECT

Unit 1: Introduce the students to computer simulation explaining its capabilities, potential and limitations. Programming of basic numerical algorithms. Correct and judicious use of basic numerical methods. Ability to choose 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.
## STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<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>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>10.00</td>
</tr>
</tbody>
</table>

**Total learning time:** 150 h

## CONTENTS

### Unit 1: Basics of numerical calculus

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

**Full-or-part-time:** 67h 15m
- Theory classes: 18h
- Laboratory classes: 9h 30m
- Self study : 39h 45m

### Unit 2: Ordinary differential equations

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

**Full-or-part-time:** 36h 15m
- Theory classes: 12h
- Laboratory classes: 2h 30m
- Self study : 21h 45m

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

**Description:**
3.2. Fourier series.

**Full-or-part-time:** 27h 45m
- Theory classes: 9h
- Laboratory classes: 1h 30m
- Self study : 17h 15m
### Unit 4: Partial differential equations

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

**Full-or-part-time:** 18h 45m  
Theory classes: 6h  
Laboratory classes: 1h 30m  
Self study: 11h 15m

### GRADING 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


### EXAMINATION RULES.

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

### BIBLIOGRAPHY

**Basic:**

**Complementary:**
ISBN 9789708300551.