Course guide  
240022 - 240022 - Calculus II

Unit in charge:  
Barcelona School of Industrial Engineering
Teaching unit:  
749 - MAT - Department of Mathematics.

Degree:  
BACHELOR’S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year:  
2023  
ECTS Credits:  
6.0  
Languages:  
Catalan, Spanish

LECTURER

Coordinating lecturer:  
YURY FEDOROV KUZMIN

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Capacity to solve mathematical problems that can appear in engineering. Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

TEACHING METHODOLOGY

In the theoretical part of the classes, the module’s more conceptual contents will be introduced, as well as basic examples related to these contents. In addition, some demonstrations, that will help us to understand the core of these concepts will be given.

In the same classes, the practical contents of the module will be developed. On the one hand, more elaborated examples, coming from the basic concepts already seen will be presented. On the other hand, practical calculus methods and tools, related to the different theoretical contents, will be discussed. Students’ participation will be encouraged.

It is intended that the problems’ collections are extensive enough for the students to complete their learning process.

LEARNING OBJECTIVES OF THE SUBJECT

This subject’s main objectives are, on the one hand, to provide the student with a sufficient solvency when using calculus tools in several variables and, on the other hand, give an introduction to Differential Equations and Laplace Transform. Likewise, it is an objective that this solvency is not only manifested in the contents conceptual comprehension and in the ability to identify which tools are appropriate in each of the problems, but also in acquiring a certain calculus “fluency” and a good comprehension of the interaction of these theoretic concepts and the mathematical modelling of science and technology problems.

Specific skills: ability to address the mathematical problems that arise in the engineering. Ability to apply their knowledge on: Linear Algebra, Geometry, Differential and Integral Calculus, etc.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>60,0</td>
<td>40.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h
## CONTENTS

### 1.- Continuity and derivatives of functions with several variables

**Description:**
- Domain
- Limit
- Continuity
- Derivatives
- Rule of the Chain
- Taylor Expansion
- Theorem of the inverse and implicit function
- Extremes

**Related competencies:**
- CE1. Capacity to solve mathematical problems that can appear in engineering. Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

**Full-or-part-time:** 80h  
Theory classes: 32h  
Self study: 48h

### 2.- Integration functions with several variables

**Description:**
- Riemann's integral
- Calculation of integrals
- Cavalieri's principle
- Fubini's theorem
- Variable changes
- Areas and volumes
- Approximate integration
- Applications

**Related competencies:**
- CE1. Capacity to solve mathematical problems that can appear in engineering. Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

**Full-or-part-time:** 50h  
Theory classes: 20h  
Self study: 30h

### 3.- Introduction to Differential Equations and to the Laplace Transform

**Description:**
- Introduction to Ordinary Differential Equations
- Laplace Transform
- Applications to the calculus of some improper integrals and to the solution of some problems in physics

**Related competencies:**
- CE1. Capacity to solve mathematical problems that can appear in engineering. Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

**Full-or-part-time:** 20h  
Theory classes: 8h  
Self study: 12h
**GRADING SYSTEM**

The evaluation consists of the following activities:

- A partial exam in the middle of the semester (EP1) in the timetable set by the School for its realization.
- A partial exam in the second part of the course (EP2) on the date the School establishes for the final exams.
- An exam related with the practical work developed along the course (P).

The final mark (NF) is:

\[ NF = 0.4 \times EP1 + 0.5 \times EP2 + 0.1 \times P. \]

Those students with mark NF less than 5, and provided they have marks in all the previous assessment activities (EP1, EP2, P), can access to a global assessment (the "reevaluation"), that consists of:

- An exam where all the program of the course will be assessed (ER) on the date the School establishes for its realization.

The final mark, taking into account the reevaluation (NR) is:

\[ NR = \max(NF, ER). \]

**BIBLIOGRAPHY**

**Basic:**

**Complementary:**

**RESOURCES**

**Other resources:**
Students will be able to access to the subject's Intranet and also to its webpage, where all the necessary material considered suitable for autonomous learning will be uploaded.