Degree competences to which the subject contributes

Specific:
3. (ENG) Capacitat per a la resolució dels problemes matemàtics que puguin platenjar-se a l'enginyeria. Aptitud per aplicar els coneixements sobre: àlgebra lineal; geometria, geometria diferencial; càlcul diferencial i integral; equacions diferencials i amb derivades parcials; mètodes numèrics; algorítmica numèrica; estadística i optimització.

G01. (ENG) DIS: Capacitat per a la resolució dels problemes matemàtics que puguin plantejar en l'enginyeria. Aptitud per aplicar els coneixements sobre: àlgebra lineal, geometria, geometria diferencial, càlcul diferencial i integral, mètodes numèrics, tècniques d'estadística.
3200012 - M2 - Mathematical Methods II

Teaching methodology

- Lectures presenting content.
- Face-to-face sessions of practical work.
- Independent work study and conducting exercises.
- Preparation and implementation of individual and / or group activities.

In the sessions of explanatory content teacher introduce the theoretical foundations of the subject, concepts, methods and illustrated with suitable examples to facilitate understanding results. The students will independently study to assimilate the concepts, solve exercises either manually or with the help of computer.

Students will become familiar in the use of a mathematical software package in order to use it as a tool for numerical, symbolic and graphic calculation.

Learning objectives of the subject

Students will have to consolidate the fundamental concepts of differential and integral calculus in several variables, in their analytical and numerical aspects. While it will have to acquire some knowledge of the usual techniques of manipulation and calculation, using support tools will be enhanced: he's familiar with the use of a mathematical software package in order to use it as a calculation tool numeric, symbolic and graphic.

It is also intended that students come into contact with the techniques of numerical solution of problems, in this case, in the context of the problems of the calculus.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 30h</th>
<th>20.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>30h</td>
</tr>
<tr>
<td></td>
<td>Hours small group:</td>
<td>0h</td>
</tr>
<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>90h</td>
</tr>
</tbody>
</table>
3200012 - M2 - Mathematical Methods II

Content

**TOPIC 1: INTRODUCTION TO NUMERICAL ANALYSIS**

**Learning time:** 40h  
Theory classes: 8h  
Practical classes: 8h  
Self study: 24h

**Description:**
1.1. Introduction to numerical methods.  
1.3. Polynomial interpolation.  
1.4. Numerical integration.

**Specific objectives:**
- Understand the concepts of numerical method, absolute error and relative error.  
- Understand bisection techniques and the Newton-Raphson method for solving equations numerically.  
- Understand the Lagrange interpolation method and Runge's phenomenon.  
- Understand the basic techniques of numerical integration: methods of rectangles, trapezoids and parabolas (Simpson).

**TOPIC 2: MULTIVARIABLE DIFFERENTIAL CALCULUS**

**Learning time:** 40h  
Theory classes: 8h  
Practical classes: 8h  
Self study: 24h

**Description:**
2.1. Domains. Continuity and contour lines.  
2.2. Partial and directional derivatives; gradients.  
2.3. Differentiability. Chain rule.  
2.4. Linear approximation. Taylor's polynomial.  
2.5. Optimisation.

**Specific objectives:**
For students to:  
- Understand the concepts of continuous and differentiable multivariable functions.  
- Correctly interpret the meaning of partial derivatives, directional derivatives and gradient vectors.  
- Properly use the concept of linear approximation.  
- Correctly use basic operations and the technique of optimisation.
### TOPIC 3: MULTIPLE INTEGRATION

<table>
<thead>
<tr>
<th>Description:</th>
<th>Specific objectives:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1. Concept. Description of domains.</td>
<td>For students to:</td>
</tr>
<tr>
<td>3.2. Fubini's theorem.</td>
<td>- Understand the concept of multiple integrals and Fubini's theorem.</td>
</tr>
<tr>
<td>3.3. Change of variables.</td>
<td>- Properly define domains of integration.</td>
</tr>
<tr>
<td>3.4. Applications.</td>
<td>- Become familiar with some applications of multiple integration.</td>
</tr>
</tbody>
</table>

**Learning time:** 40h
- Theory classes: 8h
- Practical classes: 8h
- Self study: 24h

### TOPIC 4: VECTOR CALCULUS

<table>
<thead>
<tr>
<th>Description:</th>
<th>Specific objectives:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1. Vector fields. Field lines.</td>
<td>For students to:</td>
</tr>
<tr>
<td>4.2. Line integrals. Conservative fields.</td>
<td>- Understand the concept of vector fields and field lines.</td>
</tr>
<tr>
<td>4.3. Curl and divergence. Classical theorems.</td>
<td>- Understand the concept of line integrals and how to calculate them.</td>
</tr>
</tbody>
</table>

**Learning time:** 30h
- Theory classes: 6h
- Practical classes: 6h
- Self study: 18h
## Planning of activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ACTIVITY 1: COMPUTER-ASSISTED WORK</strong></td>
<td>10h</td>
<td>10h</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The main objective is to be able to solve problems of numerical calculation (item 1) using Maple V.</td>
<td></td>
<td></td>
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<tr>
<td><strong>Support materials:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notes about Maple V related to item 1 will be provide at the beginning of the course.</td>
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<td></td>
</tr>
<tr>
<td><strong>ACTIVITY 2: COMPUTER-ASSISTED WORK</strong></td>
<td>10h</td>
<td>10h</td>
</tr>
<tr>
<td><strong>ACTIVITY 3: EXAMS</strong></td>
<td>8h</td>
<td>8h</td>
</tr>
<tr>
<td><strong>Hours:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theory classes:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Qualification system

The evaluation of the course will be partial evaluations by the following weights:
- Midterm exams: 70% (First exam: 25%, Second exam: 45%)
- Laboratory: 20%
- Tasks: 10%

## Regulations for carrying out activities

Assessments consist of acts of classroom and other activities that are part of the continuous assessment. If the student does not realize any of these activities, the qualification shall be considered as zero.
Bibliography

Basic:


Complementary:


Others resources:

- Lists of exercices
- Maple script