Degree competences to which the subject contributes

Specific:

1. 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:

3. 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

Teaching methodology is a combination of lectures in the classroom and homeworks, along with a midterm and a final exam.

Learning objectives of the subject

To present the fundamental concepts of differential and integral calculus of several variables, and linear algebra. To develop the ability to applying them to engineering problems.
## Study load

<table>
<thead>
<tr>
<th></th>
<th>Hours large group:</th>
<th>Hours medium group:</th>
<th>Hours small group:</th>
<th>Guided activities:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total learning time:</strong></td>
<td>150h</td>
<td>60h</td>
<td>0h</td>
<td>0h</td>
<td>90h</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>40.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>60.00%</td>
</tr>
</tbody>
</table>
### Content

<table>
<thead>
<tr>
<th><strong>(ENG) Linear algebra and geometry</strong></th>
<th><strong>Learning time:</strong> 40h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 16h</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td></td>
</tr>
<tr>
<td>Identify and characterize vector spaces and subspaces, and manipulate vectors. Identify diagonalizable endomorphisms.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>(ENG) Functions of several variables</strong></th>
<th><strong>Learning time:</strong> 30h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 12h</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td></td>
</tr>
<tr>
<td>Study of functions of several variables with emphasis on the concepts and methods of differential calculus of several variables.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>(ENG) -Extrema of real functions of several variable</strong></th>
<th><strong>Learning time:</strong> 15h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td>Local and global extrema. Test for local extrema. Constrained extrema. Lagrange multiplier method.</td>
<td>Self study: 9h</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td></td>
</tr>
<tr>
<td>To acquire the basic tools for analyzing extrema problems, both free and constrained extrema problems.</td>
<td></td>
</tr>
</tbody>
</table>
820008 - ACM - Algebra and Multivariable Calculus

<table>
<thead>
<tr>
<th>(ENG) -Multiple integration and applications</th>
<th>Learning time: 30h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 12h</td>
</tr>
<tr>
<td>Double integral: definition and properties.</td>
<td>Self study: 18h</td>
</tr>
<tr>
<td>Change of variables for double integrals.</td>
<td></td>
</tr>
<tr>
<td>Triple integral: definition and properties.</td>
<td></td>
</tr>
<tr>
<td>Change of variables for triple integrals.</td>
<td></td>
</tr>
<tr>
<td>Applications for the double and triple integral: volume</td>
<td></td>
</tr>
<tr>
<td>computations, center of mass and moments of inertia.</td>
<td></td>
</tr>
</tbody>
</table>

| Specific objectives: | Ability for solving problems of multiple integration and its application to problems of science and engineering. |

<table>
<thead>
<tr>
<th>(ENG) Differential geometry and field theory</th>
<th>Learning time: 35h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 14h</td>
</tr>
<tr>
<td>Parametrized curves. Vector fields and scalar</td>
<td>Self study: 21h</td>
</tr>
<tr>
<td>fields. Operators: gradient, divergence and</td>
<td></td>
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<tr>
<td>curl. Conservative vector field and its associated</td>
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<tr>
<td>potential function. Line integral. Green's</td>
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</tr>
<tr>
<td>theorem. Surface integral. Divergence and</td>
<td></td>
</tr>
<tr>
<td>Stoke's theorems.</td>
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</tr>
</tbody>
</table>

| Specific objectives: | Ability to provide analytical descriptions of curves and surfaces, calculate their properties and perform differential and integral calculus operations on them. Applications in field theory. |

**Qualification system**

The evaluation will be conducted through the assessment by the teacher. Students can pass the subject through continuous assessment based on exams and performing exercises. The objective of ‘Self-Learning ‘ will be evaluated with a weight of 5 %.

Two exams will be administered during the quarter, P1 with weight 40% and P2 with weight 40%

Learning Objective (LO): 5%
Problems/Controls/Solving problems: 15%

The grade is calculated as follows:

\[ P1 \times 40\% + P2 \times 40\% + LO \times 5\% + \text{Homeworks} \times 15\% \]

Students that failed ordinary evaluation and have been regularly attending tests throughout the course will have the option to perform a re-evaluation test during the period specified in the academic calendar.
Bibliography

Basic:

Complementary: