The first objective of this course is extending to functions of several variables the concepts learned in the course of Calculus I, for one variable functions. In particular we study the concepts of differentiability of functions of several variables, multiple integration, and integration on curves and surfaces and their applications to physics and engineering. It also introduces basic concepts of geometry such as curves and surfaces, with the aim of studying the fundamental theorems of vector analysis, theorems of Green, Stokes and Gauss. These theorems are the theoretical study of...
electromagnetic fields.

Learning Outcome:
- Domain solving math problems that may arise in physics, and the ability to apply their knowledge of geometry, vector analysis, differential and integral calculus (several variables).
- Use the resources and services available to run simple searches. Classifies and summarizes the information gathered.
- Carries out the tasks on schedule, according to the guidelines set by the teacher or tutor.
- It raises the problem correctly from the proposed language and identify options for resolution.
- Apply the appropriate solution method and identifies the correct solution.
- Identify, model and poses problems from open situations. Explore and implement alternatives for resolution. Known approximations.

<table>
<thead>
<tr>
<th>Study load</th>
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<tbody>
<tr>
<td><strong>Total learning time:</strong> 150h</td>
<td>Hours large group:</td>
<td>65h</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>85h</td>
</tr>
</tbody>
</table>
# Content

## Topology. Limits and continuity of functions of several variables.

**Learning time:** 11h 30m  
Theory classes: 3h 30m  
Practical classes: 2h 15m  
Self study: 5h 45m

**Description:**  
Vector sequences.  
Functions of several variables. Level sets. Limits. Continuity.

## Differentiability of functions of several variables.

**Learning time:** 32h 20m  
Theory classes: 7h 45m  
Practical classes: 5h 35m  
Self study: 19h

**Description:**  
Implicit function theorem and inverse function.

## Taylor's formula.

**Learning time:** 12h 55m  
Theory classes: 4h 05m  
Practical classes: 2h 10m  
Self study: 6h 40m

**Description:**  

## Applications of differential calculus: Extremals.  
Differential operators. Curves and surfaces.

**Learning time:** 23h  
Theory classes: 5h 50m  
Practical classes: 4h 25m  
Self study: 12h 45m

**Description:**  
Critical points. Local extremes. Sufficient conditions of extremals.  
Extreme conditions. Lagrange multipliers.  
Absolute extremals.  
Curves and surfaces. Parametrizations.
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<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td><strong>Multiple integrals.</strong></td>
<td>27h 30m</td>
<td>Theory classes: 6h 05m Practical classes: 4h 55m Self study: 16h 30m</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
<td>Double and triple integrals. Definition of integral (Riemann), Fubini theorem. Change of variable. Functions defined by integrals and derivation under the integral sign. Improper integrals. Applications.</td>
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<tr>
<td><strong>Integrals along curves and integrals on surfaces.</strong></td>
<td>16h 10m</td>
<td>Theory classes: 4h 40m Practical classes: 3h 10m Self study: 8h 20m</td>
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<tr>
<td><strong>Theorems of vector calculus.</strong></td>
<td>26h 35m</td>
<td>Theory classes: 7h 05m Practical classes: 4h 30m Self study: 15h</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
<td>Theorems of Green, Stokes and Gauss-Ostrogadski. Applications.</td>
</tr>
</tbody>
</table>

**Qualification system**

The rating will consist of a final exam (FE) and an evaluation along the course that will take into account the implementation of a mid-term exam (EP).

The final rating will be given by

$$\text{max} \{EF, 0.65 * EF + 0.35 * EP\}$$
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Bibliography

Basic:


Complementary: