Degree competences to which the subject contributes

At the end of the course, the student must be capable of:

a) Develop a series of functions of one variable.

b) Interpolate two-dimensional data sets.
c) Define the concept of differentiable function of several variables.
d) Calculate, interpret and apply partial derivatives, directional derivatives, the differential matrix and the Hessian.
e) Solve systems of overdetermined non-linear equations.
f) Define the concepts of double and triple integral.
g) Calculate double integral and triple integral.
h) Use variable changes for the resolution of integrals.
i) Calculate areas, moments of inertia, and centers of gravity.

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 24h</th>
<th>16.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 36h</td>
<td>24.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study: 90h</td>
<td>60.00%</td>
</tr>
</tbody>
</table>
### Content

#### C1 Single variable calculus

**Learning time:** 42h  
Theory classes: 6h 30m  
Practical classes: 6h 30m  
Guided activities: 0h  
Self study: 29h

**Description:**  
Review on elementary functions and derivation.  
Interpolation of bidimensional datasets.  
Series expansions.  
Single variable integration: definition and change of variables.

**Related activities:**  
MV1, E1

**Specific objectives:**  
At the end of the activity, the student has to be capable of:  
- a) Choose and use suitable methods to interpolate bidimensional datasets.  
- b) Expand single variable functions and control its error.  
- c) Compute, at a basic level, integrals of single variable functions.

#### C2 Multivariable differential calculus

**Learning time:** 60h  
Theory classes: 9h  
Practical classes: 9h  
Guided activities: 0h  
Self study: 42h

**Description:**  
Scalar and vector fields.  
Directional and partial derivatives.  
Differential map.  
Linearization of vector fields.  
Optimization in several variables. Extrema.  
Least square method. Overdetermined systems of nonlinear equations.  
Composition of vector fields. Chain's rule.  
Implicit derivation.

**Related activities:**  
MV2, E1, E2

**Specific objectives:**  
At the end of the activity, the student must be capable of:  
### C3 Multivariable integral calculus

**Description:**
- Double integral.
- Calculation of the double integral.
- Change of variables.
- Calculation of areas of flat surfaces.
- Triple integral.
- Calculation of the triple integral.
- Moments of inertia and center of gravity of a solid body.
- Integral curvilinear and conservative fields.

**Related activities:**
MV3, E2

**Specific objectives:**
At the end of the activity, the student must be capable of:
- Use all the calculus resources needed to calculate double and triple integrals and apply it to the special cases of calculation of areas and moments of inertia and center of gravity of a solid body. Identify a conservative field.
- Calculate curvilinear integrals and potential functions. Resolution of application exercises using a symbolic calculator as a calculation tool.
### Planning of activities

#### MV1: CONTINUOUS EVALUATION. DEVIATION OF ONE-VARIABLE FUNCTIONS

**Description:**
Short 60-minutes control or problem-solving to deliver. The activity can involve working in groups, the use of mathematical software or oral presentation.

**Support materials:**
Individual notes of the student and of the subject available at ATENEA. Math software. Web resources linked to ATENEA.

**Descriptions of the assignments due and their relation to the assessment:**
The activity will be delivered in person. Its resolution can be consulted through Atenea.

**Specific objectives:**
At the end of the activity the student must be able to consolidate the concepts of Derived from function in a variable, its physical and geometrical interpretation and be able to develop functions of one variable in Taylor series.

<table>
<thead>
<tr>
<th>Hours</th>
<th>Self study: 1h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### MV2: CONTINUOUS EVALUATION LINEARIZE SCALAR FIELDS

**Description:**
Short 60-minutes control or problem-solving to deliver. The activity can involve working in groups, the use of mathematical software or oral presentation.

**Support materials:**
Individual notes of the student and of the subject available at ATENEA. Math software. Web resources linked to ATENEA.

**Descriptions of the assignments due and their relation to the assessment:**
The activity will be delivered in person. Its resolution can be consulted through Atenea.

**Specific objectives:**
At the end of the activity the student must be capable of Calculate differential applications of functions in several variables, directional derivatives and linearize vector fields.

<table>
<thead>
<tr>
<th>Hours</th>
<th>Self study: 1h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### E1: EVALUATION BLOCK 1 AND BLOCK 2.1

**Description:**
Solve problems corresponding to the contents of Block 1 and Block 2.1.

**Support materials:**
Statement for the test. Calculator as calculation support.

<table>
<thead>
<tr>
<th>Hours</th>
<th>Theory classes: 2h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**310600 - Calculus**

**MV3: CONTINUOUS EVALUATION. OPTIMIZATION OF VARIOUS VARIABLES.**

<table>
<thead>
<tr>
<th>Description:</th>
<th>Hours: 1h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short 60-minutes control or problem-solving to deliver. The activity can involve working in groups, the use of mathematical software or oral presentation.</td>
<td>Self study: 1h</td>
</tr>
</tbody>
</table>

**Support materials:**
- Individual notes of the student and of the subject available at ATENEA.
- Math software.
- Web resources linked to ATENEA.

**Descriptions of the assignments due and their relation to the assessment:**
- The activity will be delivered in person. Its resolution can be consulted through Atenea.

**Specific objectives:**
- At the end of the activity the student must be able to solve integration problems develop at the class.

---

**MV4. CONTINUOUS EVALUATION. INTEGRATION OF VARIOUS VARIABLES.**

<table>
<thead>
<tr>
<th>Description:</th>
<th>Hours: 1h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short 60-minutes control or problem-solving to deliver. The activity can involve working in groups, the use of mathematical software or oral presentation.</td>
<td>Self study: 1h</td>
</tr>
</tbody>
</table>

**Support materials:**
- Individual notes of the student and of the subject available at ATENEA.
- Math software.
- Web resources linked to ATENEA.

**Descriptions of the assignments due and their relation to the assessment:**
- The activity will be delivered in person. Its resolution can be consulted trough Atenea.

**Specific objectives:**
- At the end of the activity the student must be able to solve integration problems develop at the class.

---

**E2: EVALUATION BLOCK 2.2 AND 3**

<table>
<thead>
<tr>
<th>Description:</th>
<th>Hours: 2h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solve related problems to the contents o Block 2.2 and Block 3.</td>
<td>Theory classes: 2h</td>
</tr>
</tbody>
</table>
**310600 - Calculus**

---

**Support materials:**
- Statement for the test.
- Calculator as calculation support.

**Descriptions of the assignments due and their relation to the assessment:**
- Deliver on paper.
- Its resolution can be consulted through ATENEA.

**Specific objectives:**
- At the end of the activity, the student must be able to show his competence in solving problems of application of the contents of Block 2.2 and Block 3.

---

**Reevaluation**

<table>
<thead>
<tr>
<th>Hours</th>
<th>Self study: 1h</th>
</tr>
</thead>
</table>

**Description:**
- Solving problems that correspond to the contents of the previous evaluation activities: E1 (Blocks 1 and 2.1) and E2 (Blocks 2.2 and 3). Both proofs will be held according to the official EPSEB exams' agenda.

**Support materials:**
- Statement of the exam.
- Calculator as a support tool (optional).

**Descriptions of the assignments due and their relation to the assessment:**
- On paper.
- Resolution will be published on ATENEA.

**Specific objectives:**
- All the objectives of the course.

---

**Qualification system**

Six evaluation activities will be carried out: 4 controls of continuous assessment or directed activities (MV1, MV2, MV3, MV4), 5% each, 1 control dedicated to Block 1 and part of Block 2 (E1) in the first period of exams, 40%, and 1 part dedicated to Block 2 and Block 3 (E2), 40%. The sequential order of the tests will be: MV1, MV2, E1, MV3, MV4, E2. In the reevaluation, two tests will be offered: E1-E2-R and R, which will count 50% of the total assessment each.

Calculation of the final note:
\[ N_f = \frac{5 \times (MV1 + MV2 + MV3 + MV4) + 40 \times E1 + 40 \times E2}{100} \]

All the grades are over 10. The assistance will be evaluated and the classwork. In every test, a very special emphasis will be put on the student's ability to express his / her knowledge in written and oral form (generic competence associated to the course).

**Regulations for carrying out activities**

1) If one of the evaluation tests is not done, it will be graded as zero.
2) In the lab tests, the teaching material can be used as available at the intranet.
3) In the problem test, a calculator can be used, but it is not necessary.
4) Coherence and rigour will be assessed in the written presentation of all the activities.
Bibliography

**Basic:**


**Complementary:**


**Others resources:**

In the digital campus (ATENEA) a logbook of the subject will be included, which briefly summarizes the content of each class, the tasks emanated and the resources to carry them out or consolidate the learning

**Hyperlink**

ATENEA (http://atenea.upc.edu/moodle/)

Entorn virtual de docència de la UPC desenvolupat utilitzant com a base tecnològica la plataforma de programari obert Moodle.

Tutories de fase inicial (estudiants amb nivell baix de matemàtiques)

(ENG) Resum teòrics, problemes resolts i problemes proposats de temes preliminars. http://atenea.upc.edu

**Computer material**

Matlab

Resource