



## Course guide 220086 - C2 - Calculus II

Last modified: 10/07/2023

**Unit in charge:** Terrassa School of Industrial, Aerospace and Audiovisual 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

### LECTURER

---

**Coordinating lecturer:** JAIME HARO CASES

**Others:** ANTONI GUILLAMÓN  
LEONARDO ACHO  
ILKA S. SHOSHEVA

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

---

**Specific:**

CE01-INDUS. Ability to solve mathematical problems that may arise in engineering. Aptitude to apply knowledge of linear algebra; geometry; differential geometry; differential and integral calculus; differential and partial differential equations; numerical methods; numerical algorithms; statistics and optimization. (Basic training module)

### TEACHING METHODOLOGY

---

- Presencial sessions of content exhibition.
- Presencial sessions of practical work (exercises).
- Autonomous work of study and realization of exercises.

Into the theoretical sessions will be introduced the concepts and fundamental results of each subject, as well as examples and cases. In the practical sessions, students will have to solve exercises and problems. They will help them to understand the concepts studied and to acquire the skill of expressing oneself correctly, using the notions and tools of the course.

On the other hand, students will have to solve a collection of exercises and problems. These exercises will be solved during the problem classes and also with non-presence work. Besides the partial and final examinations, during the course it will make a follow-up of the learning of the students.

They will have a collection of solved problems which has to serve as reference book and guide for the resolution of the exercises. Moreover, each teacher has some fixed consulting hours where students can solve different doubts concerning theory classes and problems.

### LEARNING OBJECTIVES OF THE SUBJECT

---

To provide the students the basic tools of the differential and integral calculation of two and three variables. Introducing vectorial calculation and their more important applications: areas of surfaces, mass centres, flows, circulations..



## STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours medium group	28,0	18.67
Hours large group	32,0	21.33

**Total learning time:** 150 h

## CONTENTS

### 1. Functions of several variables

**Description:**

Parametric representation of a curve. Scalar and vector fields. Basic topological notions: border closed, limited and compact. Graphical representation of scalar fields of two variables. Nondegenerate quadric: small equations and drawings. Level groups.

**Specific objectives:**

Parametric representation of a curve and calculate the length. Curvatura, torsion and Frenet trihedral. Graphically represent sets of level.

**Related activities:**

Classes of theoretical explanation and resolution of problems of diverse difficulty (individual and in group). Study and individual work.

**Full-or-part-time:** 27h

Theory classes: 5h

Practical classes: 3h

Self study : 19h

### 2. Differential calculus

**Description:**

Limits and continuity. Directional derivatives. Differentiability. Chain rule. Higher order derivatives. Taylor formula. Relative extrema. Conditioned ends. Absolute ends in a compact. Implicit function. Inverse function.

**Specific objectives:**

Knowing derived functions of various variables. Calculation of higher order derivatives. Study and determination of relative and absolute ends.

**Related activities:**

Theoretical explanation and resolution of problems of different difficulty classes (individual and group). Study and individual work.

**Full-or-part-time:** 41h

Theory classes: 9h

Practical classes: 8h

Self study : 24h



### 3. Integral calculation

**Description:**

Double integrals. Iterated integration. Change of variable (polar and elliptical). Triple integrals. Iterated integration. Change of variable (cylindrical and spherical). Applications: area, volume, mass, middle, center geometric center of mass and moment of inertia.

**Specific objectives:**

Calculate double and triple integrals. Apply changes of variables. Physical applications of the double and triple integrals.

**Related activities:**

Theoretical explanation and resolution of problems of different difficulty classes (individual and group). Study and individual work.

**Full-or-part-time:** 38h

Theory classes: 8h

Practical classes: 7h

Self study : 23h

### 4. Vectorial analysis

**Description:**

Vector fields and differential operators. Integral of a field scalar on a curve. Applications. Integral of a vector field along a curve. Applications. Green theorem. Parametrization of a surface. Surface integrals (fields integrated scalar and vector fields on a surface). Applications. Theorem of the divergence. Stokes theorem.

**Specific objectives:**

Parameterization of surfaces. Calculation of the integral of a field scalar and a vector field on a surface. Application of the divergence of Stokes theorems.

**Related activities:**

Theoretical explanation and resolution of problems of different difficulty classes (individual and group). Study and individual work.

**Full-or-part-time:** 44h

Theory classes: 10h

Practical classes: 10h

Self study : 24h

## ACTIVITIES

### ACTIVITY 1: THEORY CLASSES

**Description:**

Presentation of the contents of the subject by the teacher and student self-study

**Specific objectives:**

Provide students the basic tools of the differential, integral and Vector calculus.

**Material:**

Class notes. Basic bibliography.

**Full-or-part-time:** 56h

Theory classes: 26h

Self study: 30h



### ACTIVITY 2: EXERCISE CLASSES

**Description:**

Students and the teacher will solve problems in the class that have been formerly proposed.

**Specific objectives:**

Assimilate and practice the theoretical concepts discussed in class.

**Material:**

Class notes. Basic bibliography. Collection of problems. Mathematical software.

**Delivery:**

In some cases the teacher can ask students the delivery of a problem or a collection of problems.

**Full-or-part-time:** 66h

Practical classes: 28h

Self study: 38h

### ACTIVITY 3: FIRST CONTROL

**Description:**

Control after about three weeks from the beginning of course with the aim that both students and the teacher, make an initial assessment of the operation of the course and take corrective action, if necessary.

**Specific objectives:**

Provide guidance to students how to prepare the subject.

**Material:**

Class notes. Collection of exercises to solve individually. Basic bibliography.

**Delivery:**

Making an individual control.

**Full-or-part-time:** 7h

Theory classes: 1h

Self study: 6h

### ACTIVITY 4: SECOND CONTROL

**Description:**

Calculation of double and triple integrals. Permutation of the limits of integration. Changing variables. Polar, cylindrical and spherical coordinates.

**Specific objectives:**

Students should properly set the limits of integration in double and triple integrals and swap this order and calculate these integrals making a change appropriate variable, if necessary.

**Material:**

Class notes. Collection of exercises to solve individually. Basic bibliography.

**Delivery:**

Making an individual control.

**Full-or-part-time:** 7h

Theory classes: 1h

Self study: 6h



### ACTIVITY 5: PARTIAL EXAM

**Description:**

Making the partial examination of the subject.

**Specific objectives:**

Develop the knowledge acquired in the theoretical and practical sessions. Write clearly and concisely the problems and issues raised manner.

**Delivery:**

The mark of this exam represents 30 % of the final grade . If not overcome , it recovered with a score of 5 if the final exam is passed.

**Full-or-part-time:** 7h

Theory classes: 2h

Self study: 5h

### ACTIVITY 6: FINAL EXAM

**Description:**

Making a final exam with all the contents of the subject.

**Specific objectives:**

Develop the knowledge acquired in theoretical and practical sessions. Write clearly and concisely the problems and issues raised manner.

**Material:**

Tests determined from previous years available on Athena.

**Delivery:**

The mark of this exam represents 50 % of the final grade .

**Full-or-part-time:** 7h

Theory classes: 2h

Self study: 5h

## GRADING SYSTEM

The final qualification of the subject will be obtained from the four following marks with the indicated ponderation:

Final exam qualification: 50%

Partial exam qualification: 25%

First control qualification: 10%

Second control qualification: 15%

The partial and final examinations consist on one part with questions about concepts related with the learning objectives of the subject regarding the knowledge or the understanding and a set of application exercises.

## EXAMINATION RULES.

In the examinations and controls are not allowed to use of any kind of calculator, computer, mobile or similar telephone. The teacher can request the student identification in any moment during the realization of evaluation act.

The irregular actions that can go to a significant variation of the qualification of one or more students (to copy or let copy) constitute a fraudulent realization of an evaluation act. This action will mean the qualification descriptive failed and numeric of 0 in evaluation act and subject.



## BIBLIOGRAPHY

---

### Basic:

- Marsden, Jerrold E.; Tromba, Anthony. Cálculo vectorial [on line]. 6a ed. Madrid: Addison Wesley, 2018 [Consultation: 14/06/2022]. Available on : [https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB\\_BooksVis?cod\\_primaria=1000187&codigo\\_libro=7634](https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=7634). ISBN 9788420568669.
- Rogawski, Jon. Cálculo, vol. 2, Varias variables [on line]. 2a ed. original. Barcelona: Reverté, cop. 2012 [Consultation: 14/06/2022]. Available on : <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5635410>. ISBN 9788429151749.
- Leseduarte, M.C.; Llongueras, M.D.; Magaña, A. Càlcul II: problemes. Barcelona: OmniaScience, 2014. ISBN 9788494187254.

### Complementary:

- Rahman, Matiur. Applied vector analysis. Boca Raton: CRC Press, 2008. ISBN 9781420051704.
- Salas, Saturnino L [et al.]. Calculus: una y varias variables, vol. 2 [on line]. 4a ed. Barcelona: Reverté, 2002 [Consultation: 14/06/2022]. Available on : <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=5635415&query=Calculus%3A+una+y+varias+variables>. ISBN 9788429151589.
- Marsden, Jerrold E [et al.]. Cálculo vectorial: problemas resueltos. 3a ed. Argentina: Addison-Wesley Iberoamericana, 1993. ISBN 0201625644.
- Fàbrega, Albert [et al.]. Exàmens de càlcul resoltos. 2a ed. Terrassa: Cardellach Còpies, 2004. ISBN 848497877X.

## RESOURCES

---

### Hyperlink:

- <http://atenea.upc.edu>