

Course guide

240721 - 240721 - Calculus II

Last modified: 16/05/2023

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGIES AND ECONOMIC ANALYSIS (Syllabus 2018).
(Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: AMADEU DELSHAMS I VALDES

Others:

PRIOR SKILLS

Ability to solve the mathematical problems that can be posed in Industrial Technologies and Economic Analysis. Aptitude to apply the knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; numerical methods; numerical algorithm; Statistics and optimization.

TEACHING METHODOLOGY

The most conceptual contents of the course will be introduced in the theoretical classes, as well as basic examples in relation to these contents. In addition to some proofs (few), the emphasis will be put on making the student to understand the "What" and the "Why" of these concepts. The chosen examples will rely on a most "practical" formulation to help the student to see all these mathematical concepts as natural in problems that are easy to understand.

The most practical contents of the course will be developed in the practical classes and also in the laboratory sessions. On the one hand more elaborate examples will be presented. On the other hand the most practical methods and calculation tools will be practised. The exercises will be developed mainly by the teacher, but also stimulating the active participation of the student. To do this, the student will know beforehand the exercises to be developed in the next class, and some of them will be solved by the student, individually or inside a group, during the development of the class and under the supervision of the teacher.

The collections of exercises are thought to be sufficiently extensive so that the student has enough material to practise. In this way the students will be able to complete their learning in an autonomous way. In the laboratory sessions Teamwork will be encouraged and Matlab will be used as a programming tool.

LEARNING OBJECTIVES OF THE SUBJECT

The main goal of the course is that the student reaches a sufficient solvency in the use of the tools of the differential calculus and the vector calculus. In particular, of the derivation and the integration in several variables, and the calculus with curves and surfaces. Likewise, the aim of the subject is that this solvency is not only manifested in the conceptual understanding of the contents and in the ability to identify which methods are suitable for each of the Problems treated, but also in the acquisition of a certain "fluidity" of calculus and in a good understanding of the interaction between these theoretical contents and the mathematical modeling of the problems of Science and Technology.



STUDY LOAD

Type	Hours	Percentage
Hours large group	60,0	40.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

1.- Continuity and derivability of functions of several variables

Description:

Domain. Limit. Continuity. Derivability. Chain Rule. Taylor expansion. Inverse and Implicit Function Theorems. Extreme values.

Full-or-part-time: 55h

Theory classes: 11h

Practical classes: 11h

Self study : 33h

2.- Integration of functions of several variables

Description:

The Riemann integral. Integral calculus. The Cavalieri principle. The Fubini theorem. Changes of variable. Areas and volumes. Approximate integration. Applications of the integral. Center of mass. Moment of inertia.

Full-or-part-time: 35h

Theory classes: 7h

Practical classes: 7h

Self study : 21h

3. Vector Calculus

Description:

Integral of functions and vector fields on curves and surfaces. Theorems of Green, Stokes and Gauss. Extreme values and method of Lagrange Multipliers

Full-or-part-time: 45h

Theory classes: 9h

Practical classes: 9h

Self study : 27h

4. Numerical calculus: optimization

Description:

Linear optimization, the simplex method. Nonlinear optimization problems. Unconstrained and Constrained optimization, Overdetermined nonlinear systems

Full-or-part-time: 15h

Theory classes: 3h

Practical classes: 3h

Self study : 9h



GRADING SYSTEM

During the semester there will be two

- One midterm exam (ME), on the date determined by the School.
- One test about the Matlab Workshop (WE), that will take place during a workshop session and will be notified in advance.
- The final exam (FE), on the date determined by the School.

Exams will contain a mixture of computational and conceptual problems. Some of them will resemble problems from the list, while some will be brand new to you. The final exam is likely to be a mixture of multiple choice and free response problems.

The final mark (FM) will be computed according to this formula:

$$FM = \max(0.6*FE + 0.1*WE + 0.3*ME, 0.9*FE+0.1*WE)$$

The part corresponding to the Matlab Workshop will not be re-evaluated. Therefore, those students that take the re-evaluation exam (RE), the final mark will be computed according to this formula:

$$FM = 0.9*RE+0.1*WE$$

EXAMINATION RULES.

The students can bring a manuscript sheet DINA4 with formulas for the exams. Calculator is not allowed.

BIBLIOGRAPHY

Basic:

- Stewart, James. Calculus : Early Transcendentals. 7th ed. Belmont, CA [etc.]: Cengage, 2017. ISBN 9788131521052.
- Dahlquist, Germund ; Björck, Ake. Numerical methods [on line]. Mineola: Dover, cop. 2003 [Consultation: 07/10/2020]. Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=1894363>. ISBN 0486428079.
- Quarteroni, A.; Saleri, F.; Gervasio, P. Scientific computing with MATLAB and Octave [on line]. 4th ed. Heidelberg: Springer, 2014 [Consultation: 07/09/2022]. Available on: <https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-642-12430-3>. ISBN 9783642453663.
- Sydsæter, K.; Berck, P.; Strøm, A. Economists' mathematical manual [on line]. 4th ed. Berlin, Heidelberg: Springer Berlin Heidelberg, 2005 [Consultation: 29/03/2023]. Available on: <https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-540-28518-2>. ISBN 3540285180.
- Marsden, Jerrold E; Tromba, Anthony. Vector calculus. 6th ed., International ed. New York: W.H. Freeman, cop. 2012. ISBN 9781429224048.