



Course guide

240712 - 240712 - Calculus I

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: GEMMA HUGUET CASADES

Others: Delshams I Valdes, Amadeu
Huguet Casades, Gemma

TEACHING METHODOLOGY

In the lectures we will present the basic theoretical contents in combination with exercises that illustrate the notions and most important results. We will also introduce modeling problems to illustrate the potentialities of calculus in the applied sciences, with special emphasis on economy.

In the workshop sessions, the students will be introduced to the Matlab software to perform effective calculations and show its application for actual problems, including problems in economic sciences.

The collections of exercises will 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.

LEARNING OBJECTIVES OF THE SUBJECT

The main goal of the course is to provide the basic analytical and numerical tools for the analysis of real functions of a single variable, and alongside to show its use in the modelling of scientific and technical problems, particularly in economics.

This course also aims to serve as an introduction to the study methodology of the degree, as well as a fundamental support for the good understanding of the rest of the courses. To that end, we emphasize its instrumental character.

STUDY LOAD

Type	Hours	Percentage
Hours large group	56,0	37.33
Self study	90,0	60.00
Hours small group	4,0	2.67

Total learning time: 150 h



CONTENTS

Continuity

Description:

Limits. One-sided limits. Continuity. Unbounded limits. Limits at infinity. Asymptotes. Interpolation.

Full-or-part-time: 21h 30m

Theory classes: 4h

Practical classes: 4h

Self study : 13h 30m

The Derivative

Description:

Basic Differentiation Rules. The Chain Rule. Implicit Differentiation. Maximum and Minimum Values. Rolle's Theorem. The Mean Value Theorem. Taylor polynomial. Derivatives and the Shapes of Curves. Monotony. Concavity and convexity. Graphing. Optimisation Problems. Newton's method.

Full-or-part-time: 34h 30m

Theory classes: 6h

Practical classes: 6h

Self study : 22h 30m

Integration

Description:

Antiderivatives. Indefinite integrals. Riemann sums. Definite Integrals. Areas. Barrow's rule. Integration techniques: trigonometric integrals, partial fraction expression, integration by parts and integration by substitution. The Fundamental Theorem of Calculus. Numerical integration. Improper integrals. Introduction to ODEs.

Full-or-part-time: 44h

Theory classes: 10h

Practical classes: 10h

Self study : 24h

Series

Description:

Sequences of real numbers. Numerical series and convergence. Convergence tests: integral, ratio, root, comparison. Alternating series. Power series. Taylor series.

Full-or-part-time: 35h

Theory classes: 7h

Practical classes: 7h

Self study : 21h



Matlab Workshop

Description:

Transversal Lesson with the following contents: Introduction to Matlab. Symbolic manipulation. Zeros of a function: bisection, Newton. Graphing of functions. Optimization. Numerical Integration. Interpolation.

Full-or-part-time: 15h

Practical classes: 6h

Self study : 9h

GRADING SYSTEM

During the semester there will be

- One midterm exam (ME), on the date determined by the School.
- Short tests about the Matlab Workshop (WE).
- The final exam (FE), on the date determined by the School.

Exams will contain a mixture of computational and conceptual problems. The final exam is likely to be a mixture of multiple choice and free response problems. Participation in class will be taken into account in the computation of the final grade.

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:

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

BIBLIOGRAPHY

Basic:

- Stewart, James. Essential Calculus : Early Transcendentals. 2nd ed. New York: Brooks Coole, 2012. ISBN 9781133112280.
- Zill, Dennis G. A First Course in Differential Equations with Modeling Applications. 10th Edition. New York: CENGAGE Learning, 2012. ISBN 9781111827052.
- 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, Knut [et al.]. Essential mathematics for economic analysis [on line]. 5th ed. Harlow: Pearson, 2016 [Consultation: 07/10/2020]. Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=5174792>. ISBN 9781292074610.
- Sydsæter, Knut [et al.]. Further mathematics for economic analysis. New York: Prentice Hall, 2008. ISBN 9780273713289.