Universidad de Alcalá

TEACHING GUIDE

Calculus I

Degree in
Electronic Communications Engineering (GIEC)
Telematics Engineering (GIT)
Telecommunication Systems Engineering (GIST)
Telecommunication Technologies Engineering (GITT)

Universidad de Alcalá

Academic Year 2025/2026

1st Year - 1st Semester (GIEC+GIT+GIST+GITT)

Approved by the EPS School Board on June 16th, 2025

TEACHING GUIDE

Course Name:	**Calculus I**
Code:	**350001 (GIEC+GIT+GIST+GITT)**
Degree in:	**Electronic Communications Engineering (GIEC)** **Telematics Engineering (GIT)** **Telecommunication Systems Engineering (GIST)** **Telecommunication Technologies Engineering (GITT)**
Department and area:	**Física y Matemáticas** **Physics and mathematics**
Type:	**Basic (GIEC+GIT+GIST+GITT)**
ECTS Credits:	**6.0**
Year and semester:	**1st Year - 1st Semester (GIEC+GIT+GIST+GITT)**
Teachers:	See webpage: https://www.uah.es/en/estudios/estudios-oficiales/grados/asignatura/Calculus-I-350001/
Tutoring schedule:	To be determined at the beginning of the course
Language:	English

1. COURSE SUMMARY

This subject establishes the basic knowledge of Calculus that is extended in the subject named Calculus II, and that together with other subjects of the matter provide to the student the necessary scientific and instrumental bases needed to understand the matters of the qualifications that are related straight to the sector of the telecommunications Engineering.

Calculus is one of the areas that integrate the basic training in mathematics of engineers and scientists, since the physical laws must be managed in mathematical terms, therefore it is important that the students appreciate and realize from the beginning the potential and applications of Mathematics.

This subject represents a course of Calculus in one variable that will have its continuation in the calculus of several variables included in the subject Calculus II. Moreover, the contents of this subject also present direct connections with the field of differential equations included in the subject Linear Algebra.

The basic contents of the subject are differential and integral calculus in one variable with applications. It starts with a first block of theory composed by number sets, functions, limits and continuity. The course continues with integration and derivation, where the goal is to make the student understand the geometrical and physical interpretations of these tools, and to be able to apply them to obtain lengths, areas and volumes.

Laplace transform is also visited in order to provide the student with basic tools to solve some differential equations.

It is very important to remark the importance of the concepts treated, further than their apparently abstraction. The applications of these concepts are fundamental in Physics and Engineering.

Prerequisites and recommendations:

In order to face this subject successfully it is important to have a basic background in elementary functions, equations of quadratic functions and some basic skills in derivation and integration, trigonometry, and operations with complex numbers.

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following generic skills, which are defined in the Section 3 of the Annex to the Orden CIN/352/2009:

en_TR2 - Knowledge of basic subjects and technologies that enables to learn new methods and technologies, as well as to provide versatility that allows adaptation to new situations.

en_TR3 - Aptitude to solve problems with initiative, decision making, creativity, and to communicate and to transmit knowledge, skills and workmanship, comprising the ethical and professional responsibility of the activity of the Technical Engineer of Telecommunication.

en_TR4 - Knowledge for the achievement of measurements, calculations, evaluations, appraisals, examinations, studies, reports, planning of tasks and other similar works in its specific ambience of the telecommunication.

en_TRU1 - Capacity of analysis and synthesis.

Professional Skills

This course contributes to acquire the following professional skills, which are defined in the Section 5 of the Annex to the Orden CIN/352/2009:

en_CB1 - Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculation; differential equations and partial derivatives; numerical methods; numerical algorithm; statistics and optimization.

Learning Outcomes

RA1. Assimilate the concepts of numerical sequences and series, and its calculation skills.

RA2. Acquire the knowledge and skills on the main basic tools and principles of integral and differential calculus.

RA3. Acquire the knowledge of Fourier series and its application to transmission techniques on telecommunications.

RA4. Understand integral transformations and use them in order to solve certain problems.

RA5. Acquire the concept of differential equation and some numerical methods applied on them

3. CONTENTS

Contents Blocks	Total number of hours
1. Numbers, functions, limits and continuity. Complex number arithmetic. Binomic representation and operations in binomic, polar and exponential form. Euler formula. Trigonometric and hyperbolic functions. Real functions of one real variable: first definitions, properties and representation. Elementary functions. Periodic functions. Limit of functions: definition and properties. Continuity: definitions, properties and fundamental results.	18 hours (10 theory + 8 problems)
2. Differential calculus. Applications. Derivative of a function in a point. Geometric interpretation. Differentiability vs. continuity. Derivable functions and operations. Basic properties and derivatives of elementary functions. Local and absolute extrema of a function. Applications of the chain rule. Implicit derivation and derivative of the inverse function. Taylor polynomial. Taylor theorem. Optimisation.	10 hours (6 theory+ 4 problems)
3. Integral calculus. Applications. Primitive of a function. Indefinite integral: properties. Change of variable. Integration by parts. Definite integral: definition and basic properties. Fundamental theorem of calculus. Applications: area between curves, volume and area of a solid of revolution, arc length. Improper integral: definition and types.	16 hours (8 theory+ 8 problems)
4. Laplace transform. Definition, properties and table of identities. Inverse transform. Application to the solution of ODEs with constant coefficients with initial data.	8 hours (4 theory + 4 problems)
5. Sequences and numerical series. Sequences: definition, convergence. Numerical series: definition, convergence. Series of positive terms. Geometric series: radius and interval of convergence. Harmonic series. Convergence criteria. Power series: definition, convergence, and term to term differentiation and integration. Representation of functions by means of power series.	4 hours (2 theory + 2 problems)

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	58 hours (56 hours on-site +2 exams hours)
Number of hours of student work:	92
Total hours	150

4.2. Methodological strategies, teaching materials and resources

Lectures	Lectures to present and/or review a concept, and also to make conclusions. Problem solving lectures by the teacher and/or by the student.
Resources and didactic materials	The material enumerated in the references will be used. Sheets of activities and additional material will be also provided.

5. ASSESSMENT: procedures, evaluation and grading criteria

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines as indicated in Article 10, students will have a period of fifteen days from the start of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default, according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

Ordinary call

In case of those students who for well-taken reasons do not have its registration formalized in the date of commencement of the course or of the period of teaching of the subject, the stated term will begin to calculate from its incorporation to the studies.

- In the case of final assessment, the student will make a unique written final exam, which will be held at the end of the semester. The grading obtained in this exam will turn into the final grade of the student.
- Those students following the continuous assessment are not allowed to take part in the final assessment. In this case, the grading is as follows:

1. The final grading of the student is calculated as the weighted sum of the marks obtained in two continuous assessments, to be held arounfd the middle of the course (PEI1) and at the end of the course (PEI2), and the mark obtained for the assignments throughout the term.

2. The value of the continuous assessments in the final grade is 40% each, the remaining 20% corresponds to the assignments throughout the course.

3. The first exam (PEI1) can be taken again (as a resit exam) at the end of the semester. The grade of a student who takes the exam PEI1 twice will be the maximum among the two grades obtained.

Extraordinary call

Every student who has not succeeded in the ordinary call can make a written test in the extraordinary call. It will be held at the end of the academic course. The grade obtained by a student in this exam will be the final grade of the student.

In case an student has succeeded to grade in the ordinary call cannot opt for the extraordinary call.

5.2. EVALUATION

EVALUATION CRITERIA

The assessment criteria measure the level in which the competences have been acquired by the student. For that purpose, the following are defined:

CE1. The student has acquired skills on the use of methods and techniques of the study of convergence of series.

CE2. The student is able to analyse and solve differential and integral analysis exercises. The student is able to formulate and solve geometric problems.

CE3. The student has acquired the knowledge and practice to work with integral transforms.

CE4. The student has attained skills to solve differential equations.

GRADING TOOLS

The work of the student is graded in terms of the evaluation criteria above, through the following tools:

1. Ordinary call

   a) Assessment exams (PEI1, PEI2). The assessments will consist of a written test. They will consider both of theoretical and practical questions.

   b) Assignments throughout the term

   c) Final assessment (PEF)

2. Extraordinary call. Final assessment (PEF)

GRADING CRITERIA

Ordinary call. Continuous assessment

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TR3, TR4, TRU1, CB1	RA1, RA2	CE1, CE2	PEI1	40%
	RA2, RA4	CE3, CE4	PEI2	40%
	RA1, RA2, RA3, RA4	CE1, CE2, CE3, CE4	Assignments during the term	20%

The final grading of the student is calculated as the weighted sum of the marks obtained in the continuous assessments PEI1, PEI2 and the assigned tasks throughout. The grade "Not Presented" will be applied to those students who satisfy one of the following conditions:

1. Having attended none of the assessments PEI1 and PEI2.
2. Having attended, exclusively, the assesment PEI1 held in the middle of the course.

The assignments throughout the term are not taken into account to determine the grade "Not

presented".

Ordinary call. Final assessment

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TR3, TR4, TRU1, CB1	RA1-RA4	CE1-CE5	PEF	100%

In the case of final assessment, the qualification of "Not presented" will apply to those students who have not participated in the final assessment exam.

Extraordinary call

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TR3, TR4, TRU1, CB1	RA1-RA4	CE1-CE5	PEF	100%

In the extraordinary call case, the qualification of "Not Presented" will apply to those students who have missed the exam corresponding to the extraordinary call.

The teaching-learning methodology and the assessment process will be adapted as needed, in accordance with the guidelines of the Diversity Support Unit, to implement curricular adaptations for students with specific needs.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- Cálculo en una variable. Jon Rogawski. Ed. : Reverté, 2da edición, 2012.
- Cálculo I. Larson, Hostetler & Edwards. Ed. Mc-Graw Hill, 2006.
- Cálculo integral metodología y problemas. Fernando Coquillat, 1ra edicion. Tebar Editorial, 1980.
- Calculus, una y varias variables, Vol. 1, S.L. Salas, E. Hille y G.J. Etgen, Editorial Reverté, 2002.
- Ecuaciones diferenciales con aplicaciones de modelado. Dennis G. Zill. CENGAGELearning, 2009.
- Matemáticas avanzadas para ingeniería. Glyn James. Prentice-Hall, 2002.
- Métodos matemáticos. Isaías Uña, Jesús San Martin, Venancio Tomeo. Thomson, 2005.
- Problemas resueltos en una variable. Venancio Tomeo, Isaías Uña, Jesús San MartínMoreno, Ed. Paraninfo, 2005.

Disclosure Note

During the evaluation tests, the guidelines set out in the Regulations establishing the Rules of Coexistence of the University of Alcalá must be followed, as well as the possible implications of the irregularities committed during said tests, including the consequences for committing academic fraud according to the Regulation of Disciplinary Regime of the Students of the University of Alcalá.