Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2025/26

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree GITECI30 - Bachelor`s Degree in Industrial Technology Engineering **Year** Second year

COURSE

27309 - Extended Mathematics **Credits, ECTS:** 6

COURSE DESCRIPTION

"Extended Mathematics" is a 2nd year and 1st term subject of the "Advanced Sciences" module M06 of the Degree in Industrial Technology Engineering.
Its contents complement many of the contents of the subjects "Calculus" and "Linear Algebra" of the 1st course, and are useful for the study of other subjects of the same course and later, such as "Differential Equations" or "Electrical Engineering", among others. Additionally, there is a part related to the use of the software "Mathematica" that can be very useful in other subjects of the degree and professional practice. By taking this course, students will acquire mathematical knowledge, methods, and skills that will be very useful in engineering practice.
It is recommended to have completed the subjects of "Calculus" and "Linear Algebra" in the 1st year, as well as to know and handle with ease basic concepts of trigonometry.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Competencies:
- Ability to solve mathematical problems that arise in the field of engineering.
- Aptitude to apply knowledge related to complex numbers and complex variable functions, integral transforms (Laplace and Fourier), solving ordinary differential equations and systems (initial value problems), Fourier series, and solving nonlinear equations.

Learning outcomes:
- Skill in symbolic and numerical computation in engineering problems modeled by algebraic and/or differential equations, both linear and nonlinear.
- Handling of the complex variable and the Laplace and Fourier transforms in engineering applications.
- Computational skills to solve by computer complex numerical approaches associated with engineering problems modeled by algebraic and/or differential equations.

Theoretical and Practical Contents

In this course, it will be studied basic concepts of the theory of complex numbers and complex variable functions, integral transforms (Laplace and Fourier), harmonic analysis, and numerical resolution of nonlinear equations, to be able to approach other subjects in which these mathematical tools are applied.
The course is divided into the following topics:
0- Solving non-linear equations
1- Complex numbers
2- Laplace Transform
3- Complex variable functions
4- Fourier series
5- Fourier transform
Topic 0 is worked in the practices of the course, programming with Mathematica the numerical methods of bisection, secant and Newton-Raphson.
In topics 1 and 3 the algebra and the different expressions of complex numbers are studied, together with the elementary complex variable functions and the main theorems of the theory of complex variable functions.
In topic 2 different properties of the Laplace transform are seen, as well as its application to solve initial value problems, common in engineering. It is also worked in the practices of the course.
In topic 4 we study the harmonic analysis of periodic functions of one variable, of great application in engineering. It is also worked in the practices of the subject.
In topic 5 different expressions and properties of the Fourier transform are studied. It is also worked in the practices of the course.

TEACHING METHODS

The following teaching-learning tools will be used throughout the course:
- Face-to-face classes in which the theoretical concepts of the subject will be explained. In the virtual classroom of the course, the students will be able to access the "Lecture Notes" corresponding to each topic, as well as different exercises (solved or proposed).
- Classroom classes of problems in which exercises will be solved and others will be proposed to be solved by the students.
- Seminars in which complementary activities will be carried out, individually or in groups (written exercises, oral presentations on previously proposed problems, etc.).
- Computer practices in which the students will learn to use the software "Mathematica" for the resolution of problems in which the theoretical and practical contents of the subject appear.
- Tutorial hours so that students can consult their doubts and so that the teachers can make a more individualized follow-up of their learning.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	22,5	9	15		13,5				
Horas de Actividad No Presencial del Alumno/a	33,75	13,5	22,5		20,25				

Legend: M: Lecture-based | S: Seminar | GA: Applied classroom-based groups | GL: Applied laboratory-based groups | GO: Applied computer-based groups | GCL: Applied clinical-based groups | TA: Workshop | TI: Industrial workshop | GCA: Applied fieldwork groups

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Exercises, cases or problem sets 20%
- Complementary activities in seminars 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The following methodology will be applied to evaluate the learning outcomes:
1. Continuous evaluation:
The continuous evaluation will use as instruments the following face-to-face tests (each one valued between 0 and 10 points):
- A first written test around week 9 of the four months on topics 1, 2 3 (grade Ne1, 35% of the final grade).
- A first computer test during one of the last seminar or computer practice sessions of the course, or at a previously announced date, or distributed in shorter sessions and previously announced during the computer practice sessions of the course (grade No1, 20% of the final grade).
- Complementary activities evaluated during the seminars (grade Ns, 10% of the final grade).
- A second written test, on the same day of the final evaluation, on topics 4, and 5 (grade Ne2, 35% of the final grade).
- A second computer test (grade No2) on the same day of the final evaluation, where it will be possible to improve the grade No1 obtained during the course. This test will be optional for those who have already obtained 5 or more points in the first computer test (No1).
The grade in the computer part will be No = No2 except for those who only took the first computer test, in which case No = No1.
The grade in the written part is Ne = (Ne1 + Ne2) / 2.
The weighted average is N = 0.70 Ne + 0.20 No + 0.10 Ns.
To pass the subject, in addition to the weighted average N of 5 or more points, it is necessary to get 3 or more in the first written part, 3 or more in the second written part, 4 or more in the written part, and 3 or more in the computer part, i.e. Ne1>=3, Ne2>=3, Ne>=4, No>=3.
The final grade in the subject will be the weighted average N when all the above requirements are met, and otherwise, the lower value between N and 4.5.
2. Final evaluation:
Students may choose the final evaluation system. To do so, they must follow the instructions of Article 8 (Chapter 2) regarding the "Evaluation Systems of the Regulations for the Evaluation of Students in Official Undergraduate Degrees".
The final evaluation will use as instruments the following face-to-face tests (each one valued between 0 and 10 points):
- A written test of topics 1, 2, and 3 (grade Ne1, 40% of the final grade).
- A written test of topics 4, 5 (grade Ne2, 40% of the final grade).
- A practical computer test (grade No, 20% of the final grade).
The first two tests will be taken without interruption, and the third one after a short break.
The grade for the written part is Ne = (Ne1 + Ne2) / 2.
The weighted average is N = 0.80 Ne + 0.20 No.
To pass the course, in addition to the weighted average N of 5 or more points, it is necessary to get 3 or more in the first written part, 3 or more in the second written part, 4 or more in the written part, and 3 or more in the computer part, i.e. Ne1>=3, Ne2>=3, Ne>=4, No>=3.
The final grade in the subject will be the weighted average N when all the above requirements are met, and otherwise, the lower value between N and 4.5.
Clarifications:
1) No books, notes, calculators, or electronic devices may be used during the tests. Any change in this regard will be notified in advance.
2) To renounce the exam, it will be enough not to show up (in case of final evaluation) or not to show up for the last written part (grade Ne2, in case of continuous evaluation).
3) In no case will any grade from one academic year be saved for another.
4) The grades Ne of the written part "approved" (5 or more points, with 3 or more in each one) and the grades No of the computer part "approved" (5 or more points) are kept for the extraordinary call (without prejudice of being able to repeat

any of both to raise the grade, although in that case, the valid grade will always be the last one, whether it has improved or not).
5) If exceptional circumstances, such as a pandemic, require it, additional tests may be performed or evaluable deliverables may be requested to lighten the written and computer tests described above.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation in the resit exam will use as instruments the following face-to-face tests (each one valued between 0 and 10 points):
- A written test of topics 1, 2, and 3 (grade Ne1, 40% of the final grade).
- A written test of topics 4, 5 (grade Ne2, 40% of the final grade).
- A practical computer test (grade No, 20% of the final grade).

The first two tests will be taken without interruption, and the third one after a short break.
The grade in the written part will be Ne = (Ne1 + Ne2) / 2 unless the test of the extraordinary convocation has not been taken because there is already a grade Ne saved from the ordinary one, in which case it is used.
The grade in the computer part is the grade No obtained in the extraordinary exam, unless it has not been taken because there is already a grade No saved from the ordinary exam, in which case it is used.
The weighted average is N = 0.80 Ne + 0.20 No.
To pass the subject, in addition to the weighted average N of 5 or more points, it is necessary to obtain 3 or more in the first written part, 3 or more in the second, 4 or more in the written part and 3 or more in the computer part, i.e. Ne1>=3, Ne2>=3, Ne>=4, No>=3.
The final grade in the subject will be the weighted average N when all the above requirements are met, and otherwise, the lower value between N and 4.5.
Clarifications:
1) No books, notes, calculator or electronic devices may be used during the tests, with the exception of the computer assigned for the computerized tests. Any change in this regard will be notified in advance.
2) In order to waive the exam, it will be sufficient not to appear.
3) In no case will any grade from one academic year be kept for another.

MANDATORY MATERIALS

- Classroom Notes available in the Egela virtual platform.
- Classroom Exercises available in the Egela virtual platform.

BIBLIOGRAPHY

Basic bibliography

- Notas de Clase, Problemas de Clase y Prácticas de Ordenador en diferentes recursos del aula virtual (eGela).
- "Advanced Modern Engineering Mathematics", Glyn James, Prentice Hall, 2011.
- "Advanced Engineering Mathematics", 10th edition, Kreyszig E., Jhon Wiley and Sons, 2011.
- "Variable Compleja y Aplicaciones", Churchill R. y Brown J, McGraw-Hill, 2004.
- "Análisis de Fourier", Hwei P. Hsu, Addison-Wesley Iberoamericana, 1973.

Detailed bibliography

- "Basic Complex Analysis", Marsden J. y Hoffman M., W. H. Freeman, 1998.
- "Variable Compleja con Aplicaciones", Wunsch D., Addison Wesley, 1997.
- "Manual de Fórmulas y Tablas Matemáticas", Spiegel, Abellanas y Liu, Serie Schaum, 2005.
- "Métodos Numéricos", Faires y Burden, Thomson, 2004.

Journals

Web sites of interest

https://egela.ehu.es/
https://www.wolfram.com/mathematica/
https://ocw.mit.edu/courses/mathematics/

OBSERVATIONS