BACHELOR'S DEGREE IN INDUSTRIAL DESIGN ENGINEERING

SYLLABUS
ALGEBRA AND CALCULUS

ACADEMIC YEAR: 2026-27
COURSE: 1st
SUBJECT TYPE: Basic Training
SEMESTER: 1st
ECTS: 6
TEACHING HOURS: 51
AUTONOMOUS WORKING HOURS: 99
TOTAL HOURS: 150
LANGUAGE/S: Spanish/Catalan
CODE: 17036

TEACHING TEAM: Marta Janeras mjaneras@elisava.net / Xavier Diego xdiego@elisava.net

PRESENTATION OF SUBJECT / GOALS

The subject aims to provide a solid base of fundamental mathematical concepts and calculation tools so that, when faced with any engineering problem, students will be able to analyse it, express it in mathematical language as well as solving it by using the tools learned.

The subject intends to show mathematics as a design tool by teaching how to generate curves and surfaces in space and transform them from mathematical equations, and using specific software to represent them. The focus of the subject is on the computational application of mathematics.

The subject is divided into two different parts: Algebra and Calculus. In Algebra, the emphasis is placed on geometric vision and transformations in space. In Calculus in the representation of curves and surfaces, on the one hand, and in the applications of derivatives and integrals, on the other.

SUSTAINABLE DEVELOPMENT GOALS (SDGS)

This subject does not specifically incorporate any SDGs.

CONTENTS

Block I: Algebra

1.1. Matrixes and systems of linear equations: basic matrix operations. Solving systems of linear equations.
1.2. Vector spaces R3: Definition of vector subspace. Base of a vector space. Change of coordinates of a vector.
1.3. Linear applications: definition and applications. Core and image. Rebase linear applications.
1.4. Diagonalization. Values and vectors. Diagonalization method. Applications.
1.5. Transformations in space: Orthogonal transformations. Classification of orthogonal transformations into R2 and R3. Isometries and rigid movements. Homogeneous coordinates.

Block II: Calculation

2.1. Curves in the plane: functions of a variable. Parametric curves. Conical. Interpolation: Lagrange, Splines and Béziers interpolation.

2.2. Surfaces in space: Functions of two variables. Representation by means of contour lines. Partial derivatives. Gradient. Relative extremes.
2.3. Optimization. Optimization problems of one and two variables. Applications.
2.4. Integration. Concept and applications. Numerical integration methods (Simpson and trapezoidal).

TEACHING METHODOLOGIES

– Work sessions with the whole group, class with the teacher. (PA)

COMPETENCIES

– The student must demonstrate that they possess and understand knowledge in an area of study that is based on Secondary Education, and it is usually at a level which, although supported by advanced textbooks, also includes some aspects that involve knowledge from the forefront of their field of study. (CB1)
– Developing a creative attitude of experimentation, under scientific and humanistic criteria, which favours the exploration of relevant and innovative contributions (CG1)
– Showing skills for the professional practice in multidisciplinary and complex environments, in coordination with networking teams either in face-to-face or virtual environments, through the computer and informational use of ICT (CT4)
– Being the main actor in the training process itself, aimed at personal and professional improvement, and acquiring a comprehensive training that allows learning and living together in a context of linguistic diversity and with very diverse social, cultural and economic realities (CT7)
– Applying the modelling and simulation techniques of industrial design engineering for the appropriate selection of processes and decision-making in the development of the project (CE2)

LEARNING OUTCOMES

– Acquiring and demonstrating advanced knowledge of the theoretical and practical aspects and work methodology in the field of calculation and modelling.
– Developing in contexts of virtual interaction through the use of ICTs.
– Defining their own learning objectives and designing coherent and realistic development processes with the same objectives and time available.
– Visualising and interpreting equations geometrically.

TRAINING ACTIVITIES

Each subject will present at the beginning of the course its WORK PLAN where the didactic activities per week / session / autonomous work are recorded.

EXAMINATION

EXAMINATION SYSTEMS

The evaluation of the subject will be based on continuous monitoring of the student's academic work throughout the course.

EXAMINATION SYSTEM	FINAL WEIGHTING
P1-Observation of participation	0
P2-Follow-up of the carried-out work	10
P4- Specific assessment tests: exams	60
P5-Carrying out of required work or projects	30

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EXAMINATION CRITERIA
The final grade of the subject will be the weighted average of the grades of the assessable activities according to the following table:

ASSESSABLE ACTIVITY	WEIGHT	RECOVERABLE (up to 50%)	EVALUATION SYSTEM
Activity-1 Performing exercises and participating in class	10%	NO	P-2
Activity-2 Computer practices	5%	NO	P-5
Activity-3 Laboratory projects	25%	YES*	P-5
Activity-4 Midterm exam	20%	NO	P-4**
Activity-5 Final exam	40%	YES*	P-4**

Students will have the option of retaking the retake tests. The retake tests will be carried out in the period of the semester allocated to this function, not being able to recover more than 50% of the subject.
* In the event that the Recoverable Assessable Activities exceed 50%, the student body may choose, up to a limit of 50%.
The unjustified non-submission of any assessable activity implies a grade of 0, even if the activity has been classified as Recoverable.
Recoverable Activities can only be recovered when they have been submitted by the student body on the indicated date and with a grade equal to or greater than 3.
** In order to calculate the final grade of the subject, it will be necessary to obtain a minimum grade of 4 in the weighted average of the exams (P-4 evaluation system).
If access to the retake test is waived, the grade achieved in the first instance will be maintained. In case of taking the recovery, the grade obtained will be the last, even if it is lower than the first.
Plagiarism or copying of other people's work is penalised in all universities and, according to the Rules of Coexistence of the University of Vic-Central University of Catalonia, they constitute serious or very serious offences. That is why in the course of this subject any indication of plagiarism or misappropriation of texts or ideas other people (What is considered plagiarism?) as well as the improper or undeclared use of Artificial Intelligence in an activity, automatically translates into a suspension and/or other disciplinary measures (Normes de Convivencia de la Universitat de Vic-Universitat Central de Catalunya).
For any questions or queries, see the (Academic Regulations of the Bachelor's Degree of the Faculty of Design and Engineering Elisava UVic-UCC).

BIBLIOGRAPHY AND TEACHING RESOURCES

– Vince. 2010. *Mathematics for computer graphics*. Springer.
– Steven J. Janke. 2014. *Mathematical Structures for Computer Graphics*. John Wiley & Sons.
– Brent Maxfield. 2006. *Engineering with Mathcad.* Butterworth-Heinemann.
– Penney, Richard C. 2015. *Linear Algebra: Ideas and Applications. John* Wiley & Sons.
– Morris, Carla C, and Robert M. Stark 2015. *Fundamentals of Calculus*. John Wiley& Sons.

The teaching staff will provide a specific bibliography at the beginning of the subject, if applicable.

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