

## Course guide

### 804221 - MAT1VJ - Mathematics

**Last modified:** 16/07/2025

**Unit in charge:** Image Processing and Multimedia Technology Centre  
**Teaching unit:** **Degree:** BACHELOR'S DEGREE IN VIDEO GAME DESIGN AND DEVELOPMENT (Syllabus 2014). (Compulsory subject).  
**Academic year:** 2025 **ECTS Credits:** 6.0 **Languages:** Catalan, English

#### LECTURER

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**Coordinating lecturer:** David del Campo Sud

**Others:** David del Campo Sud  
Felipe Calvo

#### TEACHING METHODOLOGY

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The subject consists on 4 weekly hours (2 sessions of 2 hours each).

Sessions will be dedicated to:

- Theory: concepts will be explained together with application examples.
- Resolution of practical exercises and problems.

The time dedicated to each part may vary depending on the complexity of the concepts explained and on their related exercises.

The material employed to support the lessons will be available at the virtual campus.

#### LEARNING OBJECTIVES OF THE SUBJECT

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- To identify the basic methodologies of linear algebra; geometry; differential and integral calculus; numerical and statistical methods that apply to the design and development of video games.

- To solve, through the use of mathematics, the possible problems that may arise in the design and development of video games.

#### STUDY LOAD

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Type	Hours	Percentage
Hours medium group	16,0	10.67
Hours large group	34,0	22.67
Guided activities	10,0	6.67
Self study	90,0	60.00

**Total learning time:** 150 h



## CONTENTS

### 1. Functions

**Description:**

Description and representation of functions:

- Domain and rank. Inverse function. Basic functions and representation. Types of functions.
- Definition of limit. Continuity. Asymptotes.
- Intervals. Increase/decrease. Concavity/convexity. Inflection points.

**Full-or-part-time:** 40h

Practical classes: 16h

Self study : 24h

### 2. Differential calculus

**Description:**

Description and application of derivatives and integrals:

- Definition of derivative.
- Basic derivatives, composition and higher order derivatives.
- Applications: gradient, tangent, normal, maxima and minima, optimization.
- Definition of integral.
- Indefinite and definite integrals.
- Integration methods.

**Full-or-part-time:** 30h

Practical classes: 12h

Self study : 18h

### 3. Trigonometry

**Description:**

Description of geometric relations in a triangle and main trigonometric functions:

- Fundamentals of trigonometry: degrees, radians, pi number and Pythagoras theorem.
- Unit circle and the representation of trigonometric functions.
- Trigonometric identities.

**Full-or-part-time:** 15h

Practical classes: 6h

Self study : 9h

### 4. Vectors and matrices

**Description:**

Vectorial and matricial calculus:

- Vector magnitude and basic operations.
- Dot product and cross product.
- Matrices: basic operations and properties.
- Determinant of matrix.
- Transposed, adjugate and inverse matrix.
- Applications: rotations, systems of equations and Rouché-Frobenius Theorem.

**Full-or-part-time:** 25h

Practical classes: 10h

Self study : 15h



## 5. Analytic geometry

### Description:

Description of spatial relations between geometrical elements:

- Definition of lines, circles and planes in space.
- Relative positions.

**Full-or-part-time:** 20h

Practical classes: 8h

Self study : 12h

## 6. Statistics and probability

### Description:

Basic concepts on statistical and probabilistic analysis:

- Probability and combinatorics.
- Basic statistics.

**Full-or-part-time:** 10h

Practical classes: 4h

Self study : 6h

## 7. Number systems and Boolean algebra

### Description:

Introduction to number systems and Boolean algebra:

- Number systems.
- Boolean Algebra.

**Full-or-part-time:** 10h

Practical classes: 4h

Self study : 6h

## ACTIVITIES

### Exercises and problems

#### Description:

Practical sessions with resolution of exercises and problems.

#### Specific objectives:

Solve mathematical problems that may arise in video game design. Apply knowledge about: algebra, geometry, differential and integral calculus, numerical methods and statistics.

**Full-or-part-time:** 30h

Theory classes: 12h

Self study: 18h

## GRADING SYSTEM

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The qualification of the subject will be obtained following a continuous evaluation system. There will be two written assessment tests (partial and final exams) and six (6) practical exercises in class during the course.

The weight of each part is as follows:

- Partial Exam - 30 %
- Final Exam - 30 %
- Practical Exercises (6) - 30 %
- Participation - 10 %

The pass degree is obtained on getting at least a mark of 5 in the final evaluation, computed by considering the weights detailed above. Miss-submitting an exam or tutorial exercise results on a null mark for that deliverable. If the pass mark is not achieved, there is the possibility of a reevaluation exam. The qualification of this exam will substitute those of the partial and final exams. The maximum mark to be obtained in the reevaluation is 5.

Irregular actions that may lead to a significant variation of the grade of one or more students constitute a fraudulent performance of an evaluation act. This action entails the descriptive grade of failure and a numerical grade of 0 for the ordinary global evaluation of the course, without the right to re-evaluation.

If the lecturers have indications of the use of AI tools not allowed in the evaluation tests, they may summon the students concerned to an oral test or a meeting to verify the authorship.

## EXAMINATION RULES.

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In-class exercises:

In the theory lectures, students will be given exercises to be discussed and solved in the classroom. These exercises will serve as a training for the Tutorial Exercises (individual).

Tutorial Exercises (TE):

At the end of each unit, the corresponding tutorial exercises (TE) will be delivered, to be submitted within the indicated deadline in pdf format. Complementary material (Excel, Matlab, Python) should be submitted as well.

## BIBLIOGRAPHY

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### Basic:

- Marsden, J.E.; Weinstein, A. Calculus, vol. 1 [on line]. 2nd ed. New York: Springer-Verlag, 1985 Available on: <https://authors.library.caltech.edu/25030/>. ISBN 0387909745.
- García López, Alfonsa. Cálculo I : teoría y problemas de análisis matemático en una variable. 2ª ed. Madrid: Clagsa, 1994. ISBN 8460509443.

### Complementary:

- Amer Ramon, Rafel. Àlgebra lineal: problemes, exercicis i qüestions. Terrassa: Universitat Politècnica de Catalunya, 1998.
- Lang, S. A first course in calculus. 5th ed. New York: Springer, 1998. ISBN 9780387962016.
- Lubary, J.A.; Brunat, J.M. Cálculo para ingeniería informática. Barcelona: Edicions UPC, 2008. ISBN 9788483019597.
- Tremblay, Christopher. Mathematics for Game Developers. 1. Course Technology PTR, 2004. ISBN 978-1592000388.

## RESOURCES

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### Other resources:

Mathematics LibreTexts

<https://math.libretexts.org/> />

3blue1brown Youtube channel

[https://www.youtube.com/channel/UCYO\\_jab\\_esuFRV4b17AJtAw](https://www.youtube.com/channel/UCYO_jab_esuFRV4b17AJtAw)