



Course guides

804221 - MAT1VJ - Mathematics

Last modified: 30/07/2021

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: 2021 **ECTS Credits:** 6.0 **Languages:** Spanish, English

LECTURER

Coordinating lecturer: DAVID DEL CAMPO SUD

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:

1. Interpret and master the basics of discrete mathematics, logic, algorithmics and computational complexity, and their application to the automatic processing of information using computer systems and their application for solving engineering problems.
2. Solve mathematical problems that may arise in engineering. Apply knowledge of linear algebra; geometry; integral and differential calculus; numerical methods; statistics.

Transversal:

3. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
4. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
5. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

TEACHING METHODOLOGY

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

- Use logical reasoning and mathematical instruments in an applied context.
- Apply trigonometry to solve geometric problems.
- Understand the concepts of domain, range, limit, continuity, maximum and minimum, growth and decrease, concavity and convexity, inflection point, and asymptote in order to be able to analyze and represent elementary functions graphically.
- Solve basic problems of mathematical analysis in a single variable for differentiable and integrable functions.
- Understand the basic concepts of optimization and solve applied problems.
- Describe mathematically the main geometric elements in 2D and 3D and know how to find the relationships between different elements (distances, angles, intersections...).
- Be able to operate with matrices and to find the rank of a matrix to decide if it is invertible. Understand the basic properties of determinants. Understand and be able to apply the Gauss-Jordan method to discuss and solve linear systems and to calculate the inverse of a matrix.
- Understand and apply the basic tools of probability and statistics.
- Make conversions between numbering systems.
- Understand and apply the principles of Boolean algebra.

STUDY LOAD

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

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

Subject qualification follows a continued evaluation system. There will be two written tests during the course (Partial I and Partial II), four (4) tutorial exercises to be submitted within the corresponding deadline, and a final exam.

The weights of each part are the following:

Partial Exam I - 20 %

Partial Exam II - 20 %

Final Exam - 30 %

Tutorial Exercises (4) - 20 %

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.

EXAMINATION RULES.

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, Phyton) should be submitted as well.



BIBLIOGRAPHY

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:

- Lang, S. A first course in calculus. 5th ed. New York: Springer, 1998. ISBN 9780387962016.
- Amer Ramon, Rafel. Àlgebra lineal: problemes, exercicis i qüestions. Terrassa: Universitat Politècnica de Catalunya, 1998.
- Lubary, J.A.; Brunat, J.M. Cálculo para ingeniería informática. Barcelona: Edicions UPC, 2008. ISBN 9788483019597.

RESOURCES

Other resources:

On-line math courses from MIT

<https://ocw.mit.edu/courses/find-by-topic/>

3blue1brown Youtube channel

https://www.youtube.com/channel/UCYO_jab_esuFRV4b17AJtAw