Course guide
804231 - MAT2VJ - Mathematics II

Last modified: 09/09/2026

Unit in charge: Image Processing and Multimedia Technology Centre
Teaching unit: 804 - CITM - Image Processing and Multimedia Technology Centre.

Degree: BACHELOR'S DEGREE IN VIDEO GAME DESIGN AND DEVELOPMENT (Syllabus 2014). (Compulsory subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** Catalan, English

LECTURER

Coordinating lecturer: Vergés, Jaume

Others: Vergés, Jaume
Sors, Oriol

PRIOR SKILLS

Basic knowledge in linear algebra

REQUIREMENTS

None

TEACHING METHODOLOGY

Lectures, problem-based classes and code practices.

LEARNING OBJECTIVES OF THE SUBJECT

- To describe mathematically the main 2D and 3D geometric objects: points, lines and planes.

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

- To correctly interpret the conical and cylindrical perspectives.

- To transform geometric objects through displacements, rotations and symmetries.

- To project 3D objects on a plane.

- To properly use the necessary mathematical tools in the resolution of analytical and numerical problems.

STUDY LOAD

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

Type	Hours	Percentage
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Lineal Algebra

Description:
Vector spaces.
Vector subspaces.
Basis of a subspace.
Solving systems of linear equations.
Vectors in R^2. Scalar product in R^2. Vector product in R^2: rotations. Complex numbers.
Vectors in R^3. Scalar product in R^3. Vector product in R^3.
Matrices. Matrices and vector products in R^3.
Determinants, inverse and adjoint matrices.
Points, lines and planes in R^3.

Full-or-part-time: 45h
Theory classes: 18h
Self study : 27h

Geometric transformations in 2D and 3D

Description:
Linear transformations.
Scale transformations.
Orthogonal matrices. Orientation
Rotations. Derivation of the rotation matrix. Euler's theorem.
Rotations about an axis passing through the origin.
Rotations about an arbitrary axis.
Affine transformations in 2D and 3D.
Linear transformations and affine vectors.
Homogeneous coordinates.
Transformations in homogeneous coordinates.
Points and directions.
Geometric interpretation of the last coordinate.
Transformations of normal vectors.
Quaternions.
Quaternion algebra.
Rotations using quaternions.
Spherical linear interpolation (SLERP).
Parallel projection of a 3D model onto a plane.
Perspective transformations. Shadows.
Viewing frustum. Field of view. Projections

Full-or-part-time: 90h
Theory classes: 36h
Self study : 54h

Interpolation

Description:
Interpolation between two points.
Weighted means and affine combinations.
Three points interpolations. Barycentric coordinate system.
Bilinear interpolation. Projected convexity's condition. Inverse of bilinear interpolation.
Trilinear interpolation.
Convex sets and weighted averages.
Interpolation and homogeneous coordinates.
Rational linear interpolation (hyperbolic).
Spherical linear interpolation.

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

The final qualification will be calculated from the different evaluation items:

- Virtual class exercises (participation and learning attitude): 10%
- Laboratory exercises: 30%
- Project: 15%
- Partial exam: 15%
- Final Exam: 30%

If the pass mark is not obtained, there is the possibility of a reevaluation exam. The qualification of this examen will substitute those of the partial and final exams (45% of the final qualification). 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.

All the activities and deliveries will be mandatory, if not completed they will be graded 0.

BIBLIOGRAPHY

Basic:
- Buss, Samuel R. 3-D computer graphics: a mathematical introduction with OpenGL. Cambridge [etc.]: Cambridge University Press, 2003. ISBN 0521821037.
- Dunn, F.; Parberry, I. 3D math primer for graphics and game development. 2nd ed. Boca Raton, Florida, EUA: CRC Press, 2011. ISBN 9781568817231.
- Gortler, Steven J. Foundations of 3D computer graphics. Cambridge, MA: MIT Press, 2012. ISBN 9780262017350.
- Lengyel, Eric; Smith, Emi. Mathematics for 3D game programming and computer graphics, third edition. 3rd ed. Boston: Cengage Learning, 2011. ISBN 1435458869.