# 804231 - MAT2VJ - Mathematics II

**Coordinating unit:** 804 - CITM - Image Processing and Multimedia Technology Centre  
**Teaching unit:** 804 - CITM - Image Processing and Multimedia Technology Centre  
**Academic year:** 2019  
**Degree:** BACHELOR'S DEGREE IN VIDEO GAME DESIGN AND DEVELOPMENT (Syllabus 2014). (Teaching unit Compulsory)  
**ECTS credits:** 6  
**Teaching languages:** Catalan, English

## Teaching staff
**Coordinator:** Angulo Bahon, Cecilio  
**Others:** Cayero Becerra, Julián Francisco

## Opening hours
**Timetable:** To be determined by e-mail with cecilio.angulo@upc.edu

### Degree competences to which the subject contributes

**Generical:**
CGFB1VJ. (ENG) Resoldre els problemes matemàtics que puguin plantejar-se en l'enginyeria. Aplicar els coneixements sobre: àlgebra lineal; geometria; càlcul diferencial i integral; mètodes numèrics; estadística.

**Transversal:**
CT4. 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.  
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.  
04 COE N1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.  
CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

### Learning objectives of the subject
- Describe and manipulate 2D and 3D geometric objects. Points, lines and planes.  
- Transform geometric objects by translations, rotations and symmetries.  
- Projection of 3D objects on a plane.  
- Build geometric elements and define trajectories of animations in a 3D space.  
- Interpret the conical and cylindrical perspectives.  
- Know and use tools for 3D graphical production.  
- Use differential equations for problems model and resolution, in particular those related with physical simulation.
### Study load

<table>
<thead>
<tr>
<th></th>
<th>Hours large group:</th>
<th>Hours medium group:</th>
<th>Hours small group:</th>
<th>Guided activities:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total learning time:</strong></td>
<td>150h</td>
<td>34h</td>
<td>16h</td>
<td>0h</td>
<td>10h</td>
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<td>90h</td>
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- Total learning time: 150h
- Hours large group: 34h (22.67%)
- Hours medium group: 16h (10.67%)
- Hours small group: 0h (0.00%)
- Guided activities: 10h (6.67%)
- Self study: 90h (60.00%)
### Content

<table>
<thead>
<tr>
<th>Vectors. 2D and 3D Geometry</th>
<th>Learning time: 6h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Practical classes: 2h</td>
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<tr>
<td></td>
<td>Self study: 4h</td>
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</tbody>
</table>

**Description:**
- Matrices. Matrices and vector products in $\mathbb{R}^3$.
- Determinants, inverse and adjoint matrices.

<table>
<thead>
<tr>
<th>Differential calculus with several variables.</th>
<th>Learning time: 8h</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 4h</td>
</tr>
</tbody>
</table>

**Description:**
- Functions in several variables. 2D objects given by contour lines. 3D objects given by level surfaces.
- Functions in several variables with vectorial values. Parameterized surfaces.
- Coordinate systems.

<table>
<thead>
<tr>
<th>Geometric transformations in 2D and 3D.</th>
<th>Learning time: 48h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 10h</td>
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<tr>
<td></td>
<td>Practical classes: 6h</td>
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<tr>
<td></td>
<td>Guided activities: 2h</td>
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<tr>
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<td>Self study: 30h</td>
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</tbody>
</table>

**Description:**
- Linear transformations.
- Scale transformations.
- Orthogonal matrices. Orientation
<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time</th>
<th>Description</th>
</tr>
</thead>
</table>
| Geometry for lighting and shading.         | 14h           |Theory classes: 4h  
Practical classes: 2h  
Self study: 8h  
Blinn-Phong lighting model.  
Normal vector to a surface. |
| Interpolation (I)                          | 18h           |Theory classes: 8h  
Practical classes: 2h  
Guided activities: 2h  
Self study: 6h  
Interpolation between two points.  
Weighted means and affine combinations.  
Three points Interpolations. Barycentric coordinate system.  
| Interpolation (II): Bézier curves, B-Splines, NURBS. | 16h           |Theory classes: 6h  
Practical classes: 2h  
Guided activities: 2h  
Self study: 6h  
Bézier curves.  
Particular case of Bézier curves for degree 3.  
Method of De Casteljau.  
Recursive subdivision. |
<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time</th>
<th>Description</th>
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</thead>
</table>
| Ray-Tracing. Intersections.       | 14h           | Theory classes: 4h  
Practical classes: 2h  
Guided activities: 2h  
Self study: 6h |
| Animation                         | 8h            | Theory classes: 2h  
Practical classes: 2h  
Self study: 4h |
| Kinematics                        | 18h           | Theory classes: 8h  
Practical classes: 2h  
Guided activities: 2h  
Self study: 6h |

**Description:**
- Ray-Tracing: Basic Ray-Tracing
- Intersection with rays.
- Animation: Animation of position.
- "Ease in": fixed object.
- "Ease in": moving object.
- Application of orientation representations in animation.
- Kinematics: Articulated rigid joints.
- Direct kinematics.
- Inverse kinematics.
The final qualification will be calculated from the different evaluation items:

- Class exercises: 10%
- Laboratory exercises (4): 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.

Regulations for carrying out activities

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

Bibliography

Basic:


