200122 - GD - Differential Geometry

Coordinating unit: 200 - FME - School of Mathematics and Statistics
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2017
Degree: BACHELOR'S DEGREE IN MATHEMATICS (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 7.5

Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: JAUME AMOROS TORRENT
Others: Segon quadrimestre:
JAUME AMOROS TORRENT - A, B
MARIA IMMACULADA GALVEZ CARRILLO - A
CARLES PADRO LAIMON - B

Degree competences to which the subject contributes

Specific:
1. CE-2. Solve problems in Mathematics, through basic calculation skills, taking in account tools availability and the constraints of time and resources.
2. CE-3. Have the knowledge of specific programming languages and software.
3. CE-4. Have the ability to use computational tools as an aid to mathematical processes.

Generical:
5. CB-1. Demonstrate knowledge and understanding in Mathematics that is founded upon and extends that typically associated with Bachelor's level, and that provides a basis for originality in developing and applying ideas, often within a research context.
6. CB-2. Know how to apply their mathematical knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader or multidisciplinary contexts related to Mathematics.
7. CB-3. Have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements.
8. CG-1. Show knowledge and proficiency in the use of mathematical language.
10. CG-3. Have the ability to define new mathematical objects in terms of others already know and ability to use these objects in different contexts.
11. CG-4. Translate into mathematical terms problems stated in non-mathematical language, and take advantage of this translation to solve them.
12. CG-6 Detect deficiencies in their own knowledge and pass them through critical reflection and choice of the best action to extend this knowledge.

Transversal:
4. 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.
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Teaching methodology

(Section not available)

Learning objectives of the subject

(Section not available)

Study load

<table>
<thead>
<tr>
<th>Total learning time: 187h 30m</th>
<th>Hours large group:</th>
<th>45h</th>
<th>24.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group:</td>
<td>0h</td>
<td></td>
<td>0.00%</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>30h</td>
<td></td>
<td>16.00%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>0h</td>
<td></td>
<td>0.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>112h 30m</td>
<td></td>
<td>60.00%</td>
</tr>
</tbody>
</table>
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## Content

### 1. Plane and space curves

**Description:**

**Learning time:** 16h  
- Theory classes: 4h  
- Laboratory classes: 4h  
- Self study: 8h

### 2. Elementary theory of surfaces

**Description:**

**Learning time:** 20h  
- Theory classes: 6h  
- Laboratory classes: 4h  
- Self study: 10h

### 3. Gauss curvature

**Description:**

**Learning time:** 20h  
- Theory classes: 6h  
- Laboratory classes: 4h  
- Self study: 10h

### 4. Examples of surfaces

**Description:**

**Learning time:** 12h  
- Theory classes: 2h  
- Laboratory classes: 4h  
- Self study: 6h
### 5. Fundamental equations of surface theory

**Learning time:** 12h  
Theory classes: 4h  
Laboratory classes: 2h  
Self study: 6h  

**Description:**  

### 6. Geometry on a surface

**Learning time:** 20h  
Theory classes: 6h  
Laboratory classes: 4h  
Self study: 10h  

**Description:**  
Covariant derivative and parallel transport. Geodesics, geodesic curvature, Liouville's formula. The exponential map, minimality properties of geodesics. Sums of the angles of a spherical triangle; Gauss-Bonnet's theorem and applications.

### 7. Some global results

**Learning time:** 16h  
Theory classes: 6h  
Laboratory classes: 2h  
Self study: 8h  

**Description:**  

### 8. Introduction to differential manifolds

**Learning time:** 14h  
Theory classes: 5h  
Laboratory classes: 2h  
Self study: 7h  

**Description:**  
The subject mark will be obtained from:

ME: Midterm Exam
FE: Final Exam

by the following formula:

$$\text{Final Mark} = \max( \text{FE}, 0.3 \times \text{ME} + 0.7 \times \text{FE}).$$

An extra exam will take place on July for students that failed during the regular semester.

### Regulations for carrying out activities

The exams (ME and FE) will contain theoretical and practical questions.

Only a formulary will be allowed.

### Bibliography

#### Basic:


#### Complementary:


#### Others resources:

- Famous Curves Applet Index http://www-history.mcs.st-and.ac.uk/Java/
- Wolfram mathworld curves http://mathworld.wolfram.com/topics/Curves
- National Curve bank http://curvebank.calstatela.edu/home/home.htm
- Open Geometry Gallery http://www1.uni-ak.ac.at/geom/opengeometry_gallery
- Virtual Math museum http://virtualmathmuseum.org/Surface/gallery_o
- Wolfram mathworld surfaces http://mathworld.wolfram.com/topics/Surfaces
- Other gallleries: http://faculty.evansville.edu/ck6/GalleryTwo/Introduction2