# 27013 - Geometry of Curves and Surfaces

**Información del Plan Docente**

| | |
|---|---|
| **Academic Year** | 2016/17 |
| **Academic center** | 100 - Facultad de Ciencias |
| **Degree** | 453 - Degree in Mathematics |
| **ECTS** | 10.5 |
| **Course** | 3 |
| **Period** | Annual |
| **Subject Type** | Compulsory |
| **Module** | --- |

## 1.Basic info

## 1.1.Recommendations to take this course

## 1.2.Activities and key dates for the course

## 2.Initiation

## 2.1.Learning outcomes that define the subject

## 2.2.Introduction

## 3.Context and competences

## 3.1.Goals

## 3.2.Context and meaning of the subject in the degree

## 3.3.Competences

## 3.4.Importance of learning outcomes

## 4.Evaluation

## 5.Activities and resources

## 5.1.General methodological presentation

Learning process is based on the following:

- Lectures.
- Blackboard problem-solving activities
- Computer problem-solving activities using free software.
- Teamwork, personal work.

## 5.2.Learning activities

- Work at the classroom (105 hours):
  - Lectures.

- Problem sessions.
- Computer lab (five two-hour sessions)
- Teamwork involving written and oral presentations. LaTeX prepaired texts and use of English is encouraged.
- Office hours

- Personal work (157,5 hours): Personal study, homework, etc.

## 5.3.Program

The goal of the subject "Geometry of curves and surfaces" is the study of the differential geometry of curves and surfaces in the euclidean plane and space. Class syllabus:

Part 1. Regular plane curves. Frénet's frame, tangent and normal vector fields along a curve, curvature, arc length. Fundamental Theorem for plane curves.

Part 2. Biregular spatial curves, Frénet frame (tangent, normal and binormal fields), arc length, torsion, curvature, evolute. Fundamental Theorem for spatial curves. Local canonical form.

Part 3. Regular surfaces. Local theory: 2-function graphs, charts and regular values of 3-functions. Examples. Parametrized surfaces. Curves in surfaces and Tangent plane.

Charts, coordinate vector fields, differentiable functions and maps. First fundamental form: lengths, angles and areas.

Part 4. Geometry of Surfaces. Geodesic and normal curvature. Second fundamental form and Gauss map. Types of points, principal, normal and Gauss curvature. Principal directions, asympotic curves, umbilic points. Vector and direction fields.

Ruled and minimal surfaces.

Part 5. Intrinsic Geometry. Covariant derivative and Gauss Theorema Eggregium. Isometries, conformal maps and isothermal coordinates. Geodesics and exponential map: distance and convexity. Gauss-Bonnet Theorems.

Some other topics, as those related with global geometry of curves and surfaces will be developed by the students in groups: Isoperimetric inequality, Four-vertex Theorem, Regular neighbourhoods of compact curves and surfaces, Differentiable Jordan Curve Theorem, Fenchel's Theorem, hyperbolic geometry, minimal and ruled surfaces,etc.

# 27013 - Geometry of Curves and Surfaces

## 5.4.Planning and scheduling

See the academic calendar of the Universidad de Zaragoza and the class schedules published on the School of Sciences (Facultad de Ciencias) webpage. As a general rule, there are three weekly lecture-problem periods in the first term and four in the second one. The exact deadlines for computer labs and turning assignments in will be announced in class and posted on a bulletin board and on the online platform ( Moodle ). The same will be done with the date, place and time of the exams.

## 5.5.Bibliography and recomended resources


- do Carmo, Manfredo P., *Differential geometry of curves and surfaces* , Prentice-Hall, Inc., Englewood Cliffs, N.J}, 1976, viii+503.
- Cordero, Luis A. *Geometría diferencial de curvas y superficies con Mathematica* / Luis A. Cordero, Marisa Fernández, Alfred Gray . Buenos Aires. Addison-Wesley Iberoamericana, cop. 1995
- Costa, Antonio F. *Notas de geometría diferencial de curvas y superficies* / Antonio F. Costa, Manuel Gamboa, Ana M. Porto Madrid : Sanz y Torres, D.L. 1997