27013 - Geometry of Curves and Surfaces

Información del Plan Docente

Academic Year	2017/18
Faculty / School	100 - Facultad de Ciencias
Degree	453 - Degree in Mathematics
ECTS	10.5
Year	3
Semester	Annual
Subject Type	Compulsory
Module	---

1.General information

1.1.Introduction

1.2.Recommendations to take this course

1.3.Context and importance of this course in the degree

1.4.Activities and key dates

2.Learning goals

2.1.Learning goals

2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

3.2.Competences

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

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 tasks

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- 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.Syllabus

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,

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Differentiable Jordan Curve Theorem, Fenchel's Theorem, hyperbolic geometry, minimal and ruled surfaces,etc.

5.4.Course planning and calendar

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 recommended 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