Universidad Zaragoza

Academic Year/course: 2021/22

27013 - Geometry of Curves and Surfaces

Syllabus Information

Academic Year: 2021/22
Subject: 27013 - Geometry of Curves and Surfaces
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

2. Learning goals

3. Assessment (1st and 2nd call)

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, problem-solving sessions, laboratory sessions, tutorials and autonomous work and study with the help of moodle.

4.2. Learning tasks

This course is organized as follows:

Face to face work (105 hours).

- **Lectures.**
- **Problem-solving sessions.** Blackboard problem-solving activities.
    - Teamwork involving written and oral presentations. LaTeX prepared texts and use of English is encouraged.
- **Laboratory sessions.** Computer problem-solving activities using free software (five two-hour sessions).
- **Tutorials.** Teacher will attend student during office hours.
- **Autonomous work and study** (157,5 hours).

The teaching activities and assessment tasks will take place in a face-to-face mode, except in the case that, due to the health situation, the dispositions emitted by the competent authorities and by the University of Zaragoza compel to take them to a greater or lesser extent in a telematic form.

4.3. Syllabus

The goal of the course *Geometry of curves and surfaces* is the study of the differential geometry of curves and surfaces in the euclidean plane and space.

This course will address the following topics:

- **Topic 1.** Regular plane curves. Frénet's frame, tangent and normal vector fields along a curve, curvature, arc length. Contact theory. Fundamental Theorem for plane curves. Curves as submanifolds.
- **Topic 2.** Biregular spatial curves, Frénet frame (tangent, normal and binormal fields), arc length, torsion, curvature, evolute. Fundamental Theorem for spatial curves. Local canonical form.
- **Topic 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, change of charts.
- **Topic 4.** Differentiable functions and maps. First fundamental form: lengths, angles and areas. Orientations.
- **Topic 5.** Geodesic and normal curvature. Second fundamental form and Gauss map. Types of points, principal, normal and Gauss curvature. Principal directions, asymptotic curves, umbilic points. Vector and direction fields
- **Topic 6.** Intrinsic Geometry. Covariant derivative and Gauss Theorema Egregium. 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: four-vertex theorem, regular neighbourhoods of compact curves and surfaces, differentiable Jordan curve theorem, Fenchel's theorem, hyperbolic geometry, minimal and ruled surfaces, etc.

4.4. Course planning and calendar

As a general rule, there are three weekly lecture-problem periods in the first term and four in the second one.

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the Faculty of Sciences website (http://ciencias.unizar.es/) and Moodle.

4.5. 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.

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=27013