COURSE DATA

DATA SUBJECT

Code: 34165
Name: Classical differential geometrics
Cycle: Undergraduate Studies
ECTS Credits: 12
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1107 - Degree in Mathematics	Facultat de Ciències Matemàtiques	3	Annual
1928 - Double Degree Program Physics-Mathematics	Facultat de Ciències Matemàtiques	4	Annual
1935 - Double Degree Program in Mathematics-Telematics Engineering	Facultat de Ciències Matemàtiques	3	Annual
1936 - Double Degree Program in Mathematics-Telematics Engineering	Facultat de Ciències Matemàtiques	3	Annual

SUBJECT-MATTER

Degree	Subject-matter	Character
1107 - Degree in Mathematics	Topology and differential geometry	COMPULSORY
1928 - Double Degree Program Physics-Mathematics	Cuarto Curso (Obligatorio)	COMPULSORY
1935 - Double Degree Program in Mathematics-Telematics Engineering	Tercer curso	COMPULSORY
1936 - Double Degree Program in Mathematics-Telematics Engineering	Tercer curso	COMPULSORY

COORDINATION

BELTRAN SOLSONA JOSE VICENTE

CARRERAS MARTINEZ FRANCISCO

SUMMARY

The general aim of this course is to introduce the concepts, methods and basic results of differential geometry, with special emphasis on classical geometry of curves and surfaces, and a light introduction to the concept of abstract differentiable manifold.

Primarily, it is to study low-dimensional geometric objects, curves and surfaces of Euclidean space, that support locally, a linear approximation.

This allows relating the right tool for the study and development of concepts is the differential calculus, and, almost as a consequence, linear algebra and topology.

At the end of some lessons about abstract manifolds as natural extensions to other dimensions apparently without ambient space are introduced.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

Students must have completed courses of Linear Algebra I and Geometry, Mathematical Analysis I and II, Ordinary Differential Equations and Topology. It is absolutely necessary that all have passed, although it is convenient.

COMPETENCES / LEARNING OUTCOMES

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Ability to work in teams.

Capacity for analysis and synthesis.

Capacity of abstraction and modeling.

Expressing mathematically in a rigorous and clear manner.

Knowing the time and the historical context in which occurred the great contributions of women and men in the development of mathematics.

Learn autonomously.

Possess and understand the mathematical knowledge.

Reason logically and identify errors in the procedures.

Solve problems that require the use of mathematical tools.

Visualize and interpret the solutions obtained.

DESCRIPTION OF CONTENTS

1. Curves

- Curves in the plane and in space
- Curvature and torsion. Frenet frame.
- Fundamental Theorem of the theory of curves

2. Surfaces

- Surfaces in R^3. Definition. Parameterization. Tangent plane.
- First fundamental form. Area of a parameterized surface.

3. Extrinsic local geometry

- The Gauss mpa. The Weingarten map. Second fundamental form.
- Variation of the area and minimal surfaces.

4. Intrinsic local geometry

- The Gauss' egregium theorem.
- Covariant derivative.
- Parallel transport.
- Geodesics.
- The Gauss-Bonnet theorem

5. Differentiable manifolds

- Abstract differentiable manifold.
- Basic examples: the sphere, the real projective space, the topological torus and the products of these spaces.

- Vector fields on a manifold.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	60,00
Other activities	15,00
Classroom practices	45,00
Total hours	**120,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	25,00
Independent study and work	0,00
Preparation of lessons	130,00
Preparation for assessment activities	25,00
Resolution of case studies	0,00
Total hours	**180,00**

TEACHING METHODOLOGY

The theoretical part takes place in master classes where the contents will be gradually introduced and the mathematical method. On each topic, and related theoretical knowledge, many examples are included, as well as resolving problems of the type own theme. And at the end of each topic lists will be provided exercises to be solved by the students.
Contact hours of theoretical explanation: 60
Internship Contact hours: 45
Tutored face seminars and evaluation of collections of problems: 15
The corresponding 120 contact hours are distributed as follows:
2 hour theory, and 1.5 hours each week problems.
5 sessions of 1.5 hours per semester for seminars / assessment practices.

EVALUATION

A partial control of the subject will be carried out in January and another in June. To make the stocking of the notes of the partial, these must be greater than or equal to 4 out of 10.

In the first call, the student may choose to take the two midterms or the exam of June. In The second call will have to be examined for the entire subject of the subject.

The grade of these exams will be 80% of the final grade.

In the seminar sessions, students may be asked to solve problems,proposed in advance, on the blackboard and/or submitted for correction. These problems will be graded and the grade can be complemented with the completion of questionnaires online. Alternatively, additional material may be developed, as a complement to the topics explained in the theoretical classes. These topics will be assessed by a test that will take place in one of the seminar sessions, at the end of each Semester.

The seminar grade will be 20% of the final grade and will only be taken into account when the grade average of the exam is equal to or greater than 4 out of 10.

In order to pass the subject, it will be necessary to obtain at least a 4 out of 10 in the grade average of the controls or the exam mark and that the weighted average between the exam mark (80%) and the grade of the seminars (20%) is higher than 5.

REFERENCES

- Do Carmo. "Geometría Diferencial de Curvas y Superficies", Alianza Editorial.
- Wolfgang Kühnel: "Differential Geometry. Curves-Surfaces-Manifolds", Second Edition, AMS, 2005.
- Bennis Barden y Charles Thomas: "An Introduction to Differential Manifolds" Imperial College Press, 2005.
- N. Hicks: "Notas sobre Geometría Diferencial" Editorial Hispano-Europea.

Complementary references:

- Juan Luis Monterde: "Geometria Diferencial Clàssica" http://www.uv.es/monterde/pdfs/totGDC.pdf
- Vicente Miquel: "Apuntes de Geometría III" http://www.uv.es/~miquel/Papers/ApuntesGeometriaIII
- Alfred Gray, Elsa Abbena, Simon Salamon: "Modern Differential Geometry of Curves and Surfaces with Mathematica" CRC Press.
- F.Brickell, R.S. Clark: "Differentiable manifolds an introduction", Van Nostrand Reinhold.