UNIVERSIDAD DE **MURCIA**

FACULTY OF **MATHEMATICS**

Geometric Analysis

Syllabus

Course code:	6372
Number of ECTS credits:	6
Semester:	2nd (February-June)
Recommended components:	To take advantage of this course is highly recommended good skills in General Topology and Differential Geometry.
Language of instruction:	Spanish (students are allowed to ask questions and write homeworks and exams in English)

Course description

Geometric Analysis deals with problems of common interest in Differential Geometry and Differential Equations. This field is naturally related to other branches of Mathematics such as Topology, Analysis, Complex Variables and Probability, among others. It could be said that it is characterized by the way of looking at the problems rather than by its contents. The main questions in this area often come from Riemannian Geometry (both intrinsic and extrinsic) and in its relations with Topology and Analysis. As an enlightening example, one of the most striking results is the proof of the Poincaré conjecture, by using Ricci flow, which points out the wide range of techniques employed there such as Partial Differential Equations, Functional Analysis, Riemannian Geometry, and Algebraic and Differential Topology.

Learning outcomes and competences

After completion of this course you will:

1. Know the main tools of tensorial analysis on manifolds.
2. Understand the basics of integration on manifolds.
3. Know the classic theorems of integration on manifolds.
4. Understand the Laplacian operator and its main applications.
5. Be able to deepen into any of the above topics as a starting for a future research work.

Course contents

I. Tensor analysis on manifolds

Tensors. Tensor fields on a manifold. Tensor derivations. Lie derivatives.

II. Differential forms and exterior calculus

Exterior forms. Differential forms on a manifold. Exterior differentiation and inner product. Poincaré's lemma.

III. Integration on manifolds

Orientation of manifolds. Manifolds with boundary. Integration of differential forms. Stokes and divergence theorems.

IV. Introduction to de Rham cohomology

De Rham cohomology groups. Homotopy operator. Introduction to degree theory.

V. Integration on Riemannian manifolds

Divergence theorem and classic integral theorems. Laplacian operator. Green's formulas. Applications.

References

1. Jürgen Jost, *Riemannian Geometry and Geometric Analysis*, Springer 2011.
2. Peter Li, *Geometric Analysis*, Cambridge Univ. Press 2012.
3. Peter Petersen, *Riemannian Geometry*, Springer 2006.

Further remarks

Students with disabilities or special educational needs can be addressed to Service of Attention to Diversity and Volunteering (*Servicio de Atención a la Diversidad y Voluntariado*, ADYV; http://www.um.es/adyv/) to receive timely advice on orientation or to make better use of their learning process. It could also be applied for implementation of the individual curricular adaptations of contents, methodology and assessment to guarantee equal opportunities in the development of academic career. Treatment of this data, in compliance with the Spanish Data Protection Act (Ley Orgánica de Protección de Datos) will be kept strictly confidential.