SUBJECT TEACHING GUIDE

G110 - Differentiable Manifolds

Double Degree in Physics and Mathematics
Degree in Mathematics

Academic year 2020-2021

1. IDENTIFYING DATA					
Degree	Double Degree in Physics and Mathematics Degree in Mathematics			Type and Year	Optional. Year 5 Optional. Year 4
Faculty	Faculty of Sciences				
Discipline	Subject Area: Further Algebra and Geometry Mention in Pure and Applied Mathematics				
Course unit title and code	G110 - Differentiable Manifolds				
Number of ECTS credits allocated	6	Term		Semester based (1)	
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. MATEMATICAS, ESTADISTICA Y COMPUTACION
Name of lecturer	FERNANDO ETAYO GORDEJUELA
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Other lecturers	

3.1 LEARNING OUTCOMES
- Students will recognize the topological spaces having a differentiable structure of manifold , paying special attention to the ones contained in Euclidean spaces and their quotients.
- Students will calculate the tangent and cotangent spaces to a manifold at a point, seeing that are the best linear approximations of the manifold in the point.
- Students will relate manifolds through differentiable maps , and calculate the differential of such maps , applying to the handling of submanifolds and quotient manifolds.
- Students will use vector fields as first order differential operators and as autonomous differential equations.
- Students will find the flow of a vector field and tnterpret it geometrically, seeing that such objects appear in many phenomena of nature and are of great usefulness to study them.
- Students will be friendly with basic notions of the Calculus in Manifolds and will use them to manipulate differential 1-forms, knowing Frobenius Theorem.
- Students will know the basic on Riemannian manifolds, obtaining their main properties.
- Students will specialize the theory of Riemannian manifolds to the case of surfaces in the Euclidean sapce and they will know other important examples of manifolds.
- Students will use manifolds in other mathematical/physical situations.

4. OBJECTIVES
Know and handle the basic concepts and results of the Theory of Differentiable Manifolds.
Know and use vector fields and differential forms, understanding the relation with Differential Equations.
Formulate and solve certain Differential Equations, viewing geometrically their solutions.
Know and handle Riemannian metrics and their associated operators.
Know rigorous proofs of some theorems, applying them to solve geometric problems.

6. COURSE ORGANIZATION	
CONTENTS	
1	SMOOTH MANIFOLDS.
2	DIFFERENTIABLE FUNCTIONS AND MAPS.
3	TOPOLOGY OF SMOOTH MANIFOLDS.
4	VECTOR FIELDS AND DIFFERENTIAL FORMS.
5	RIEMANN METRICS AND MANIFOLDS.
6	FINAL EXAM.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
One hour written exam	Written exam	No	Yes	24,00
One hour written exam	Written exam	No	Yes	24,00
Final exam	Written exam	Yes	Yes	52,00
TOTAL				100,00

Observations

(a) The final mark is the best of:
(1) The average of all the exams.
(2) The mark of the final exam.
(b) One pass the subjet when the averaged marks are over 5, having 3/10 or more in the final exam. In other case, the final mark is 4.9. The september exam, if necessary, is up to 10 points.

Observations for part-time students

If you are a part-time student, you have the same evaluation system.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

GAMBOA, J.M. y RUIZ, J.M. (1999). Iniciación al Estudio de las Variedades Diferenciables. Sanz y Torres.

MOORE J. Douglas . (2009). Lectures on Differential Geometry.

WARNER, F.W. (1971). Foundations of Differentiable Manifolds and Lie Groups. Scott Foresman.