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34966 - VD - Differentiable Manifolds

Coordinating unit: 200 - FME - School of Mathematics and Statistics

Teaching unit: 743 - MA IV - Department of Applied Mathematics IV

Academic year: 2014

Degree: MASTER IN ADVANCED MATHEMATICS AND MATHEMATICAL ENGINEERING (Syllabus 2010). (Teaching unit Optional)

ECTS credits: 7,5 Teaching languages: English

Teaching staff

Coordinator: FRANCESC XAVIER GRACIA SABATE

Others:

FRANCESC XAVIER GRACIA SABATE - A

Prior skills

Basic courses on algebra, calculus, topology and differential equations, and calculus on manifolds.

Degree competences to which the subject contributes

Specific:

1. RESEARCH. Read and understand advanced mathematical papers. Use mathematical research techniques to produce and transmit new results.
3. CALCULUS. Obtain (exact or approximate) solutions for these models with the available resources, including computational means.
4. CRITICAL ASSESSMENT. Discuss the validity, scope and relevance of these solutions; present results and defend conclusions.

Transversal:

5. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
6. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
7. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
8. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
9. EFFECTIVE USE OF INFORMATI0N RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.

Teaching methodology

Theory classes will be used to present and develop the contents of the course. Most of the topics will be presented by the instructors, but there can be some sessions presented by students. Along the course the students will be given problems to solve as homework.

Learning objectives of the subject

The subject focuses on the fundamental topics used in differential geometry and applications in different areas.

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By the end of the course, students should:
- Be able to understand all the ideas developed along the course.
- Be able to apply the studied concepts to other areas such as theoretical mechanics, control theory, mathematical physics or geometric dynamical systems.
- Be able to enter a research group on these kinds of topics and their applications.
- Be able to search the bibliography, and to understand the scientific literature on the subject.
- Be able to write and present an essay on mathematics.

Study load

Total learning time: 187h 30m	Theory classes:	60h	32.00%
	Self study:	127h 30m	68.00%

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Content

Basic differential geometry	Learning time: 37h 30m Large group/Theory: 12h Self study : 25h 30m
Riemannian manifolds and symplectic manifolds	Learning time: 37h 30m Large group/Theory: 12h Self study : 25h 30m
Lie groups and Lie algebras	Learning time: 50h Large group/Theory: 16h Self study : 34h
Supplements on topology and analysis	Learning time: 37h 30m Large group/Theory: 12h Self study : 25h 30m
Applications	Learning time: 25h Large group/Theory: 8h Self study : 17h

Qualification system

Evaluation is based on students' participation and homework, and on the completion and presentation of an essay (a written work) on a topic on differential geometry.
Eventually, there will be a final examination.

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Bibliography

Basic:

Lee, John M. Introduction to smooth manifolds. New York: Springer-Verlag, 2003. ISBN 0387954481.

Bott, Raoul; Tu, Loring W. Differential forms in algebraic topology. New York: Springer-Verlag, 1982. ISBN 0387906134.

Duistermaat, J. J. ; Kolk, Johan A. C. Lie groups. Berlin: Springer-Verlag, 2000. ISBN 3540152938.

Greub, W. H.; Halperin, S.; Vanstone, R. Connections, curvature and cohomology (vol. I). New York: Academic Press, 1972-1976.

Greub, W. H.; Halperin, S.; Vanstone, R. Connections, curvature and cohomology (vol. II). New York: Academic Press, 1972-1976.

Complementary:

Lee, John M. Riemannian manifolds : an introduction to curvature [on line]. New York: Springer, 1997 [Consultation: 05/06/2012]. Available on: <http://link.springer.com/book/10.1007%2Fb98852>. ISBN 038798271X.

Massey, William S. Algebraic topology: an introduction. New York: Springer-Verlag, cop. 1977. ISBN 0387902716.

Warner, Frank W. Foundations of differentiable manifolds and lie groups. New York, NY [etc.]: Springer-Verlag, cop. 1971. ISBN 0387908943.

Dieudonné, Jean. Éléments d'analyse (vol. II-V). Paris: Gauthier-Villars, cop. 2003. ISBN 2876472155.

Olver, Peter J. Applications of Lie groups to differential equations. New York: Springer-Verlag, 1986. ISBN 0387940073.