34966 - VD - Differentiable Manifolds

| Coordinating unit: | 200 - FME - Faculty of Mathematics and Statistics |
| Teaching unit: | 743 - MA IV - Department of Applied Mathematics IV |
| Academic year: | 2011 |
| Degree: | MASTER IN ADVANCED MATHEMATICS AND MATHEMATICAL ENGINEERING (Syllabus 2010). (Teaching unit Optative) |
| ECTS credits: | 7,5 |
| Teaching languages: | English |

Teaching staff

Coordinator: FRANCESC XAVIER GRACIA SABATE

Others:
FRANCESC XAVIER GRACIA SABATE - A
MIGUEL CARLOS MUÑOZ LECANDA - A

Prior skills

Calculus on manifolds.
Tangent and cotangent bundles. Differential forms and vector fields.
Elementary geometric mechanics.

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.
2. CALCULUS. Obtain (exact or approximate) solutions for these models with the available resources, including computational means.
3. CRITICAL ASSESSMENT. Discuss the validity, scope and relevance of these solutions; present results and defend conclusions.

General:
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 INFORMATION 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 devoted to student's presentations. There will be lists of problems, which will not contain solutions. Problems will be designed to help students deepen and mature their command of the concepts and techniques presented in class. Some problems will be solved in the class; some will be left as homework. Some of the problems solved in class will be presented by the students.

Learning objectives of the subject

The subject focuses on the fundamental topics used in differential geometry and applications in different areas. 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 aware of the wide range of fields and problems to which differential geometry results can be applied.

Study load

<table>
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<tr>
<th>Total learning time: 187h 30m</th>
<th>Self study: 127h 30m</th>
<th>Theory classes: 60h</th>
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<td>68.00%</td>
<td>32.00%</td>
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Content

Vector bundles and de Rham cohomology

- Learning time: 37h 30m
  - Theory classes: 10h
  - Practical classes: 2h
  - Self study: 25h 30m

Tangent distributions and Fröbenius theorem

- Learning time: 37h 30m
  - Theory classes: 10h
  - Practical classes: 2h
  - Self study: 25h 30m

Lie groups and algebras

- Learning time: 37h 30m
  - Theory classes: 10h
  - Practical classes: 2h
  - Self study: 25h 30m
In general, it will include an exam as well as class presentations. In the case of a small group, the exam may be replaced by personal work. In particular, presentations of parts of the different subjects or solved problems as well as scientific research are considered as possible alternatives to the exam.

**Qualification system**

**Bibliography**

**Basic:**


