Last update: 21/06/2010

34961 - QQMDS - Quantitative and Qualitative Methods in Dynamical Systems

Coordinating unit: 200 - FME - Faculty of Mathematics and Statistics
Teaching unit: 725 - MA I - Department of Applied Mathematics I
Academic year: 2010
ECTS credits: 7,5 Teaching languages: English

Teaching staff

Coordinator: M. TERESA MARTINEZ-SEARA ALONSO

Others: Amadeu Delshams Valdés

Opening hours

Timetable: A convenir

Prior skills

Basic knowledge of calculus, algebra and differential equations. Some basic ideas of local dynamical systems.

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. MODELLING. Formulate, analyse and validate mathematical models of practical problems by using the appropriate mathematical tools.
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.

Generical:

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.

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Teaching methodology

We don't distinguish theoretical and practical classes. Some results about modern theory in Dynamical systems are presented in class. The main idea is to give basic knowledge and useful tools in the study of a dynamical system from both quantitative and qualitative points of view. We will stress the relation between different kind of systems and we will mainly focus in the use of perturvatives techniques to study a dynamical system globally.

Learning objectives of the subject

Study load

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

Content

-Invariant objects in Dynamical Systems

Learning time: 20h

Theory classes: 5h
Practical classes: 5h
Other activities: 10h

Description:
Continuous and dicrete Dynamical Systems. Poincaré map. Local behaviour of hyperbolic invariant objects. Invariant manifolds. Central manifold. Local bifurcations.

-Perturbation theory in Dynamical Systems

Learning time: 20h

Theory classes: 5h
Practical classes: 5h
Other activities: 10h

Description:
Clasic perturbation theory. Perturbed homoclinic orbits in the plane. Melnikov method.

Last update: 21/06/2010

34961 - QQMDS - Quantitative and Qualitative Methods in Dynamical Systems

Discrete Dynamical Systems	Learning time: 20h Theory classes: 5h Practical classes: 5h Other activities: 10h

Description:
Discrete systems. Denjoy theorem. Generic properties. Sarkovskii theorem.

-Homoclinic points and chaotic Dynamics	Learning time: 20h Theory classes: 5h Practical classes: 5h Other activities: 10h

Description:
Homoclinic points and bifurcations. Hyperbolic sets and transversal homoclinic points. Dynamical systems with chaotic dynamics. Newhouse phenomenum.

-Normal forms	Learning time: 20h Theory classes: 5h Practical classes: 5h Other activities: 10h

Description:
Poincaré-Dulac normal forms. Convergence: Poincaré and Siegel domains.
Hamiltoniane normal forms. Bifurcations. Lie series. Construction of
algebraic and analytic manipulators.

-Normal forms: its aplication to stability in Dynamical Systems	Learning time: 20h Theory classes: 5h Practical classes: 5h Other activities: 10h

Description:
KAM (Kolmogorov-Arnold-Moser) theory, twist theorem. Small divisors and diophantic inequalities. Efective stability and Nekhoroshev theorem.
Splitting of separatrices, Melnikov potential. Arnold diffusion.

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Qualification system

The students have to do some problems and a research work. On the other hand they will attend the "Jornades d'iniciació als Sistemes dinàmics i les EDP"
and produce a document about them.

Regulations for carrying out activities

There are no exams.

Bibliography