Syllabus

Subject

Subject / Group	11299 - Techniques for Studying Periodic Solutions to Periodic Differential Equatio / 1
Degree	Master's Degree in Advanced Physics and Applied Mathematics
Credits	3
Period	First semester
Language of instruction	English

Professors

Lecturers	**Office hours for students**					
	Starting time	**Finishing time**	**Day**	**Start date**	**End date**	**Office / Building**
María Jesús Álvarez Torres chus.alvarez@uib.es	13:30	14:30	Monday	10/09/2018	10/02/2019	Despacho 120
Rafel Jaume Prohens Sastre rafel.prohens@uib.cat	You need to book a date with the professor in order to attend a tutoring session.					

Context

This course is part of the module Dynamical Systems with particular emphasis on the study of certain special solutions -periodic orbits- and their stability. We deserve special attention to the applications. Part of the subject will be also devoted to understand phase portraits and bifurcation diagrams.

Requirements

Recommended

It is highly recommended to have attended a course in differential equations.

Skills

Specific

* EMA1 Ability to understand the specific language of the treated application (neuroscience, images, dynamic systems) and ability to work in the field interdisciplinary. .
* EMA3 Ability to relate the theory of dynamical systems with applications in the different covered fields: mechanics, circuit theory, neuroscience... .
* CE2 Students must possess the ability to use and adapt mathematical models to describe physical phenomena of different nature. .

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* CE3 Acquire advanced knowledge in the frontiers of knowledge and demonstrate in the context of internationally recognized scientific research, a full understanding of the theoretical and practical aspects and scientific methodology. .

Generic

* CG1 systematic understanding of a field of study and mastery of the skills and methods of research associated with that field. .

Basic

* You may consult the basic competencies students will have to achieve by the end of the Master's degree at the following address: http://estudis.uib.cat/master/comp_basiques/

Content

Range of topics

1. Intoduction to the qualitative theory
    * Phase portrait
    * Singular points
    * alpha- and omega-limit set
    * Hartman-Grobman Theorem
    * Hilbert's XVI problem
2. Stability of periodic orbits
    * Transversal sections
    * Poicaré return map
    * Stability of periodic orbits
    * Semi Complete Family of Rotated Vector Fields
3. Critical points
    * Center-focus problem: Lyapunov constants,...
    * Small limit cycles: Hopf bifurcation
4. Perturbative methods
    * Abelian integrals
    * Medium limit cycles
5. Limit cycles in the cilinder
    * Ricatti equation
    * Abel equation
    * Generalized Abel equation

Teaching methodology

In-class work activities (1 credits, 25 hours)

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Modality	Name	Typ. Grp.	Description	Hours
Theory classes		Large group (G)	The basic theoretical concepts will be explained so that them could be applied to several concrete problems.	17
Seminars and workshops		Medium group (M)	These sessions will be devoted to evaluate the practical skills	2
Practical classes		Large group (G)	These sessions will be devoted to develop the practical skills	4
Assessment		Large group (G)	These sessions will be devoted to evaluate the theoretical and practical skills through an oral presentation of a memory.	2

At the beginning of the semester a schedule of the subject will be made available to students through the UIBdigital platform. The schedule shall at least include the dates when the continuing assessment tests will be conducted and the hand-in dates for the assignments. In addition, the lecturer shall inform students as to whether the subject work plan will be carried out through the schedule or through another way included in the Aula Digital platform.

Distance education tasks (2 credits, 50 hours)

Modality	Name	Description	Hours
Individual self-study		Students will devote part of their home study to study in depth the concepts explained in theory class. Students will devote part of their time to solving various problems that will be done throughout the course.	50

Specific risks and protective measures

The learning activities of this course do not entail specific health or safety risks for the students and therefore no special protective measures are needed.

Student learning assessment

Frau en elements d'avaluació

In accordance with article 33 of Academic regulations, "regardless of the disciplinary procedure that may be followed against the offending student, the demonstrably fraudulent performance of any of the evaluation elements included in the teaching guides of the subjects will lead, at the discretion of the teacher, a undervaluation in the qualification that may involve the qualification of "suspense 0" in the annual evaluation of the subject".

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Seminars and workshops

Modality	Seminars and workshops
Technique	Oral tests **(non-retrievable)**
Description	These sessions will be devoted to evaluate the practical skills
Assessment criteria	
Final grade percentage: 60%	

Assessment

Modality	Assessment
Technique	Papers and projects **(non-retrievable)**
Description	These sessions will be devoted to evaluate the theoretical and practical skills through an oral presentation of a memory.
Assessment criteria	
Final grade percentage: 40%	

Resources, bibliography and additional documentation

Basic bibliography

* "Qualitative Theory of Planar Differential Systems" Springer (Universitext); Freddy Dumortier, Jaume Llibre, Joan C. Artés. ISBN-10: 3540328939 | ISBN-13: 978-3540328933 | Edition: 2006
* "Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields" Springer (Applied Mathematical Sciences-42); John Guckenheimer and Philip Holmes; ISBN-10: 0387908196 | ISBN-13: 978-0387908199 | Edition: 1st ed. 1983. Corr. 6th printing 2002

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