Syllabus

Subject

Subject / Group	11004 - Pattern Formation / 1
Degree	Master's in Physics of Complex Systems
Credits	3
Period	1st semester
Language of instruction	English

Professors

Lecturers	**Office hours for students**					
	Starting time	**Finishing time**	**Day**	**Start date**	**End date**	**Office / Building**
Damià Agustí Gomila Villalonga	10:00	11:00	Thursday	01/10/2019	30/06/2020	216 / Instituts Universitaris

Context

This is one of the compulsory courses of the Structural Module of the master in Physics of Complex Systems. It runs paralelly and greatly complements the "Dynamical systems and chaos" course (11001) to privide the foundations for the analysis and modeling of nonlinear spatially distributed systems. The contents exposed here are necessary in several of the courses of the Specific Module, in particular the course on "Spatiotemporal dynamics" (11009) is a direct continuation of this one.

Requirements

Recommended

It is convenient to have knowledge on the basics of ordinary and partial differential equations, and on linear algebra.

Skills

Specific

* E9: To know stability analysis techniques and know how to build bifurcation diagrams.
* E12: To know the essential phenomenology of pattern formation in physical, chemical or biological systems.
* E13: To Know the multiple scales methods and how to obtain amplitude equations.

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Generic

* TG1: To be able to describe, both mathematically and physically, complex systems in different situations.
* TG2: To acquire the capacity to develop a complete research plan covering from the bibliographic research and strategy to the conclusions.
* TG3: To write and describe rigorously the research process and present the conclusions to an expert audience.

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.-. Introduction and Phenomenology

Patterns in convection and other fluid instabilities. Chemical reactions. Optics. Biological processes.

2.-. Linear stability analysis for partial differential equations

The cases of confined systems and large systems.

3.-. Weakly nonlinear analysis

Method of multiple scales. The Swift-Hohenberg model. Types of instabilities.

4.-. Amplitude equations

Generic phenomena. Ginzburg-Landau type equations. Secondary instabilities. Complex spatiotemporal behavior.

5.-. Phase dynamics

Periodic modulations of patterns and waves.

Teaching methodology

In-class work activities (0.75 credits, 18.75 hours)

Modality	Name	Typ. Grp.	Description	Hours
Theory classes	Theoretical lectures	Large group (G)	Exposition of theoretical concepts by the lecturer.	9.5
Practical classes	Practical sessions and demonstrations	Large group (G)	Resolution of problems and questions. Observations of nonlinear phenomena.	6.5
Assessment	Exam	Large group (G)	The exam is intended to evaluate the knowledge adquired by the students. It will contain problems and some conceptual questions.	2.75

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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 (2.25 credits, 56.25 hours)

Modality	Name	Description	Hours
Individual self-study	Assignments	The student has to solve assigned exercises and present the solutions in written form.	28.25
Individual self-study	Study and understanding theoretical concepts	The student should understand and assimilate the theoretical concepts and techniques explained in the lectures.	28

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 Regulation of academic studies, "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".

Exam

Modality	Assessment
Technique	Objective tests **(retrievable)**
Description	The exam is intended to evaluate the knowledge adquired by the students. It will contain problems and some conceptual questions.
Assessment criteria	Accuracy of the answers. Clarity and quality of the explanations

Final grade percentage: 80%

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Assignments

Modality	Individual self-study
Technique	Papers and projects **(retrievable)**
Description	The student has to solve assigned exercises and present the solutions in written form.
Assessment criteria	Accuracy of the results. Clarity and quality of the explanations and interpretation of the results. Quality of the written presentation

Final grade percentage: 20%

Resources, bibliography and additional documentation

Basic bibliography

M. Cross and H. Greenside, Pattern Formation and Dynamics in Nonequilibrium Systems, Cambridge University Press 2009.
D. Walgraef, Spatio-Temporal Pattern Formation, Springer 1997.

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