Subject identification

Subject	11004 - Pattern formation
Credits	0.75 in-class (18.75 hours) 2.25 distance (56.25 hours) 3 totals (75 hours).
Group	Group 1, 1S
Teaching period	1st semester
Teaching language	English

Lecturers

Lecturers	Timetable for student attention					
	Starting time	Finishing time	Day	Start date	Finish date	Office
Emili Hernandez Garcia	There are no defined sessions					

Degrees where the subject is taught

Degree	Character	Academic year	Studies
Master's Degree in Physics of Complex Systems	Optional		Postgraduate degree

Contextualisation

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

Recommendable

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

Skills

This course develops both specific and generic skills:

Date of publication: 20/09/2012

Specific

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

Generic

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

Content

Theme content

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

Modality	Name	Typ.Gr.	Description
Theory classes	Theoretical lectures	Large group (G)	Exposition of theoretical concepts by the lecturer.
Practical classes	Practical sessions and demonstrations	Large group (G)	Resolution of problems and questions. Observations of nonlinear phenomena.

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Modality	Name	Typ.Gr.	Description
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.

Distance education work activities

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

Riscs especifics i mesures de protecció

Les activitats d'aprenentatge d'aquesta assignatura no comporten riscs específics per a la seguretat i salut de l'alumnat i, per tant, no cal adoptar mesures de protecció especials.

Workload estimate

Modality	Name	Hours	ECTS	%
In-class work activities		**18.75**	**0.75**	**25**
Theory classes	Theoretical lectures	9.5	0.38	12.67
Practical classes	Practical sessions and demonstrations	6.5	0.26	8.67
Assessment	Exam	2.75	0.11	3.67
Distance education work activities		**56.25**	**2.25**	**75**
Individual self-study	Assignments	28.25	1.13	37.67
Individual self-study	Study and understanding theoretical concepts	28	1.12	37.33
	Total	**75**	**3**	**100**

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 Campus Extens platform.

Student learning assessment

Date of publication: 20/09/2012

Exam

Modality	Assessment
Technique	Objective tests **(Non-recoverable)**
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

Percentage of final qualification: 50% following path A

Assignments

Modality	Individual self-study
Technique	Papers and projects **(Non-recoverable)**
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

Percentage of final qualification: 50% following path A

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.

Complementary bibliography

Other resources

Date of publication: 20/09/2012