Subject identification

Subject	10104 - Cooperative and Critical Phenomena: Applications
Credits	1.2 de presencials (30 hours) 3.8 de no presencials (95 hours) 5 de totals (125 hours).
Group	Group 1, 1S
Teaching period	1st semester
Teaching language	English

Professors

Lecturers	Horari d'atenció alumnes					
	Starting time	Finishing time	Day	Start date	Finish date	Office
Tomás Miguel Sintes Olives tomas.sintes@uib.es	09:30h	10:30h	Thursday	22/09/2014	24/07/2015	207 (Edifici Instituts Universitaris de Recerca)

Contextualisation

The aim of this subject is to train potential researchers in the study of critical phenomena, the dynamics of phase transitions, pattern formation and fractal growth far from equilibrium and the dynamics of complex networks by using the tools and methodologies of statistical physics and nonlinear dynamics.

Requirements

Recommendable

It is highly recommended that students have taken statistical physics courses during their undergraduate studies.

Skills

Specific

* To understand the critical and cooperative phenomena from the perspective of cross-disciplinary physics and complex systems (E4).
* To understand the meaning of concepts like scaling laws, and to apply the techniques of the renormalization group (E5).

Date of publication: 21/07/2014

* To know the main concepts of non equilibrium statistical physics, including reticular models and growth (E7).
* To understand the main concepts and techniques of complex networks (E15).
* To understand the basic concepts of the classic and quantic information theory: Shanon entropy, complexity, colectivities, quantum entanglement (E18).

Generic

* To acquire the capacity to develop a complete research plan covering from the bibliographic research and strategy to the conclusions (TG2).
* To write and describe rigoroulsy the research process and present the conclusions to an expert audience (TG3).
* To acquire high power computation skills and advanced numerical methods capabilities in applications to problems in the contex of complex systems (TG6).

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

Theme content

Chapter 1. Introduction to phase transitions and critical phenomena

Chapter 2. Reticular models and universality classes

Chapter 3. The mean field approach. The Landau theory. The hamiltonian of Ginzburg-Landau

Chapter 4. Scale Invariance

Chapter 5. The renormalization group

Chapter 6. Kinetic Ising models

Chapter 7. Kinetics of self-aggregation and gelation. The DLA model

Chapter 8. The percolation theory

Chapter 9. Surface growth and the KPZ equation

Teaching methodology

In-class work activities

Modality	Name	Typ. Grp.	Description	Hours
Theory classes	Theoretical Lectures	Large group (G)	Lectures: The students will acquire the knowledge and methodologies to understand the basic concepts in the study of cooperative and critical phenomena.	30

Date of publication: 21/07/2014

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.

Distance education work activities

Modality	Name	Description	Hours
Group or individual self-study	Autonomous work	Autonomous work: The students will apply the concepts and techniques learned during the lectures to solve specific problems. The students will present the results obtained in a rigorous way and will be evaluated.	95

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

Theoretical Lectures

Modality	Theory classes
Technique	Papers and projects **(non-retrievable)**
Description	Lectures: The students will acquire the knowledge and methodologies to understand the basic concepts in the study of cooperative and critical phenomena.
Assessment criteria	The participation of the students along the lecturing period will be evaluated, as well as the completion of short proposed problems.

Final grade percentage: 50%

Date of publication: 21/07/2014

Autonomous work

Modality	Group or individual self-study
Technique	Papers and projects **(retrievable)**
Description	Autonomous work: The students will apply the concepts and techniques learned during the lectures to solve specific problems. The students will present the results obtained in a rigorous way and will be evaluated.
Assessment criteria	Public presentation of the results of a selected projects proposed by the professor.

Final grade percentage: 50%

Resources, bibliography and additional documentation

Basic bibliography

1. J. M. Yeomans, "Statistical Mechanics of Phase Transitions". Oxford Sci. Pub (2002).
2. P. M. Chaikin and T. C. Lubensky, "Principles of Condensed Matter Physics". Cambridge Univ. Press (2000)
3. E. Stanley, "Introduction to Phase Transitions and Critical Phenomena". Oxford Sci. Pub (1987)
4. P. Meakin, " Fractals, scaling and growth far from equilibrium". Cambridge University Press, (1998).

Date of publication: 21/07/2014