Universitat de les Illes Balears

Teaching guide

Academic year	2012-13
Subject	10104 - Cooperative and Critical Phenomena: applications
Group	Group 1, 1S
Teaching guide	A
Language	English

Subject identification

Subject	10104 - Cooperative and Critical Phenomena: applications
Credits	1.2 in-class (30 hours) 3.8 distance (95 hours) 5 totals (125 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**
Maximino San Miguel Ruibal msr260@uib.es	There are no defined sessions					
Tomás Miguel Sintes Olives tomas.sintes@uib.es	12:00h	13:00h	Monday	24/09/2012	21/09/2013	207 Edifici Instituts Universitaris

Degrees where the subject is taught

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

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

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Recommendable

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

Skills

Specific

1. To understand the critical and cooperative phenomena from the perspective of cross-disciplinary physics and complex systems (E4).
2. To understand the meaning of concepts like scaling laws, and to apply the techniques of the renormalization group (E5).
3. To know the main concepts of non equilibrium statistical physics, including reticular models and growth (E7).
4. To understand the main concepts and techniques of complex networks (E15).
5. To understand the basic concepts of the classic and quantic information theory: Shanon entropy, complexity, colectivities, quantum entanglement (E18).

Generic

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

Content

Theme content

Chapter 1. Critical phenomena and the renormalization group.

Chapter 2. Reticular models and dynamics far from equilibrium.

Chapter 3. Growth models and aggregation.

Chapter 4. The dynamics of phase transition. Nucleation and dynamic scaling.

Chapter 5. Dynamics of complex networks

Teaching methodology

In-class work activities

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Modality	Name	Typ.Gr.	Description
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.

Distance education work activities

Modality	Name	Description
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.

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		**30**	**1.2**	**24**
Theory classes	Theoretical Lectures	30	1.2	24
Distance education work activities		**95**	**3.8**	**76**
Group or individual self-study	Autonomous work	95	3.8	76
	Total	**125**	**5**	**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

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Theoretical Lectures

Modality	Theory classes
Technique	Papers and projects **(Non-recoverable)**
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.

Percentage of final qualification: 50% following path A

Autonomous work

Modality	Group or individual self-study
Technique	Papers and projects **(Recoverable)**
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 project proposed by the professor.

Percentage of final qualification: 50% following path A

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).
5. R. Albert, A.-L. Barabási, "Statistical mechanics of complex networks", Rev. Mod. Phys. 74, 47 (2002); S.N. Dorogovtsev, J.F.F. Mendes, "Evolution of networks", Adv. Phys. 51, 1079 (2002).

Complementary bibliography

Other resources

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