Universitat de les Illes Balears

Syllabus

Subject

Subject / Group 11003 - Complex Networks / 1
Degree Master's Degree in Physics of Complex Systems
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
Juan Fernández Gracia	11:00	12:00	Wednesday	16/10/2018	30/06/2019	Ed. Instituts universitaris, S05 (basement)
Victor Martinez Eguiluz	12:00	13:00	Thursday	01/10/2018	31/01/2019	201 / Ed Inst. Univ.

Context

This is one of the compulsory courses of the Structural Module of the Master of Physics of Complex Systems.

The aim of this subject is to introduce the recent developments of the so-called Theory of Complex Networks.

Requirements

Recommended

It is highly recommended that students have taken statistical physics courses during their undergraduate studies and have at least basic knwoledge of computational methods.

Skills

Specific

* E2: To develop and aplly optimally numerical algorithms for the simulation of complex systems .
* E15: To understand the main concepts and techniques of complex networks .

Date of publication: 02/07/2018

Before printing this document, please consider whether or not it is necessary. We all share the environment.
©2018 University of the Balearic Islands. Cra. de Valldemossa, km 7.5. Palma (Balearic Islands). Ph.: +34 - 971 17 30 00. E-07122. VAT Reg No: Q0718001A

Document automatically generated at 1001:56 of 12/12/2018

Generic

* TG2: To acquire the capability to develop a complete research project: bibliographic search, subject development and ellaboration of conclusions .
* TG3: To be able to write in a clear, precise and rigorous way the different steps of the research process and to present the results to an expert audience .
* ´TG6: To acquire high computational skills and advanced numerical methods capabilities in applications to problems in the context of complex systems .

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
   History of complex networks. Sociology and Mathematics.
   Examples of networks. Biological, social, technological networks.
   Random networks. The Erdõs-Rényi model.
   Regular Networks.

2. Small-world networks
   Diameter and clustering. Empirical evidence.
   Watts-Strogatz model.

3. Scale-free networks.
   Distribution of degree. Empirical evidence.
   Barabasi-Albert model.
   Choice. Configurational model.

4. Characterization of networks.
   Correlations of degree. Asortativity. Betweenness.
   Communities. Detection of communities.
   Motifs.

5. Resilience of complex networks.
   Percolation theory.
   Tolerance of complex networks to errors and attacks.

6. Advanced complex netwokrs
   Directed networks; weighted nets.
   Multilayer networks
   Temporal networks

7. Computational modeling of compelx Networks
   Introduction to Python's NetworkX
   Visualization with Gephi

Before printing this document, please consider whether or not it is necessary. We all share the environment.
©2018 University of the Balearic Islands. Cra. de Valldemossa, km 7.5. Palma (Balearic Islands). Ph.: +34 - 971 17 30 00. E-07122. VAT Reg No: Q0718001A

Document automatically generated at 1001:56 of 12/12/2018

Teaching methodology

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

Modality	Name	Typ. Grp.	Description	Hours
Theory classes	Lectures	Large group (G)	The students will acquire the concepts and methodology to understand state-of.-the-art research in complex networks.	18.75

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	Assigments & oral presentation	The students will apply the concepts and techniques learnt during the lectures to solve assignments. The students will also present the final project as a short oral presentation and as a written report.	56.25

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".

Before printing this document, please consider whether or not it is necessary. We all share the environment.
©2018 University of the Balearic Islands. Cra. de Valldemossa, km 7.5. Palma (Balearic Islands). Ph.: +34 - 971 17 30 00. E-07122. VAT Reg No: Q0718001A

Document automatically generated at 1001:56 of 12/12/2018

Lectures

Modality	Theory classes
Technique	Papers and projects **(non-retrievable)**
Description	The students will acquire the concepts and methodology to understand state-of.-the-art research in complex networks.
Assessment criteria	Participation in the lectures. Accuracy and quality of the presented work.

Final grade percentage: 50%

Assigments & oral presentation

Modality	Individual self-study
Technique	Papers and projects **(non-retrievable)**
Description	The students will apply the concepts and techniques learnt during the lectures to solve assignments. The students will also present the final project as a short oral presentation and as a written report.
Assessment criteria	Presentation (both oral and written) and quality of the project proposed by the lecturer.

Final grade percentage: 50%

Resources, bibliography and additional documentation

Basic bibliography

A.-L. Barabási, Network Science (Cambridge University Press, 2016) http://networksciencebook.com/
M.E.J. Newman, Networks: An Introduction (Oxford University Press, 2010).
S Fortunato, Community detection in graphs,Physics Reports 486, 75-174 (2010).
S. Boccaletti et al, Complex networks: structure and dynamics, Phys. Rep. 424, 175-308 (2006).
M.E.J. Newman, The structure and function of complex networks, SIAM Rev. 45, 167-256 (2003).
R. Albert, A.-L. Barabási, Statisical Mechanics of complex networks, Rev. Mod. Phys. 74, 47-97 (2002).

Before printing this document, please consider whether or not it is necessary. We all share the environment.
©2018 University of the Balearic Islands. Cra. de Valldemossa, km 7.5. Palma (Balearic Islands). Ph.: +34 - 971 17 30 00. E-07122. VAT Reg No: Q0718001A

Document automatically generated at 1001:56 of 12/12/2018