Universitat de les Illes Balears

Syllabus

Academic year	2017-18
Subject	11018 - Turbulence and Nonlinear Phenomena in Fluids
Group	Group 1, 2S
Syllabus	A
Language	English

Subject

Name	11018 - Turbulence and Nonlinear Phenomena in Fluids
Credits	0.75 in-class (18.75 hours) 2.25 distance (56.25 hours) 3 total (75 hours).
Group	Group 1, 2S
Period	Second semester
Language	English

Lecturers

Lecturers	**Office hours for students**					
	Starting time	**Finishing time**	**Day**	**Start date**	**End date**	**Office**
Cristóbal López Sánchez	You need to book a date with the professor in order to attend a tutorial.					

Context

This is one of the courses of the Specific Module of the master of Physics of Complex Systems.

Requirements

Recommended

It is recommended that the student has a basic knowledge of fluid mechanics, at the level of the undergraduate studies in the degree of physics.

Skills

Specific

* E8: Understand generic behavior of dynamical systems and their instabilities.
* E10: To acquire the capability to characterize chaos and compute Lyapunov exponents.

Generic

* TG2: To acquire the capability to develop a research plan covering from the bibliographic research and strategy to the conclusions.
* TG3: To be able to write in a clear and precise way the different steps of the research work and to present the results to an expert audience.
* TG6: To develop the capability to understand and to apply knowledge of high perfomance computation and advanced numerical methos to the field of complex systems.

Date of publication: 18/07/2017

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. Instabilities and transition to turbulence.

Chapter 2. Eulerian and Lagrangian description of fluid flows. The equations of fluid dynamics.

Chapter 3. Fully developed turbulence.
- 2/3 Law and the Law of energy disipation.
- Kolmogorov's 41 Theory.
- Two dimensional flows.

Chapter 4. Intermittency and Multifractality.

Chapter 5. Dispersion in fluid flows.
- Turbulent and shear dispersion.
- Relative dispersion.

Chapter 6. Chaotic Advection.
- Hamiltonian Dynamics and KAM tori.
- Open flows.

Chapter 7. Lyapunov Exponents.
- Finite-time and Finite-size Lyapunov Exponents.
- Hyperbolic structures and manifolds.
- Applications to ocean dynamics.

Chapter 8. Mixing of the passive scalar.

Teaching methodology

In-class work activities

Modality	Name	Typ. Grp.	Description	Hours
Theory classes	Lectures	Large group (G)	Explanation of theoretical concepts by the professor.	17.75
Assessment	Oral presentation	Large group (G)	Oral presentation to the whole class of an assigned problem.	1

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

Date of publication: 18/07/2017

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
Individual self-study	Autonomous work	The students have to apply the concepts and techniques learned during the lectures to solve assigned exercises, and present the solutions in written form.	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

Oral presentation

Modality	Assessment
Technique	Objective tests **(non-retrievable)**
Description	Oral presentation to the whole class of an assigned problem.
Assessment criteria	Quality and accuracy of the presented work, as well as the clarity in the oral exposition.

Final grade percentage: 50%

Autonomous work

Modality	Individual self-study
Technique	Papers and projects **(non-retrievable)**
Description	The students have to apply the concepts and techniques learned during the lectures to solve assigned exercises, and present the solutions in written form.
Assessment criteria	The students have to apply the concepts and techniques learned during the lectures to solve assigned exercises, and present the solutions in written form.

Final grade percentage: 50%

Resources, bibliography and additional documentation

Basic bibliography

U. Frisch. *Turbulence: the legacy of A.N. Kolmogorov.* Cambridge Univ. Press, 1995

E. Hernandez-Garcia and Z. Neufeld. *Chemical and Biological Processes in Fluid Flows: A Dynamical Systems Approach,* Imperial College Press, 2009.

Date of publication: 18/07/2017

Other resources

The lecture notes, presentations and other additional material will be available at the master's webpage.