

23-24

DEGREE



# MÁSTER UNIVERSITARIO EN FÍSICA DE SISTEMAS COMPLEJOS

CODE 215601

UNED

23-24

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SISTEMAS COMPLEJOS  
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## INTRODUCTION

**PSA: The Master's Degree in Physics of Complex Systems is in the process of extinction since the academic year 2021/2022, so it does not admit new students. As of the 2023/2024 academic year, there will be no faculty attention or tutoring. See section "Sobre la extinción del título" for more information. UNED degree catalog offers alternatives to this master's degree (see Master Degree in Advanced Physics).**

This master's degree is intended as an academic training and/or initiation to research in advanced physics, and complements undergraduate studies in Sciences (Physics, Chemistry, Mathematics) and Engineering. Students are allowed to establish their own curricular lines according to their expectations, being always advised by a master's tutor who is assigned by the Coordinating Committee.

From a general point of view, complex systems are characterized by a rich and complicated behavior rather than by their intrinsic definition. They appear in many and very diverse fields: Physics, Mathematics, Biology, Chemistry, Engineering, Economics, etc. These systems are characterized by the existence of a very high number of "agents" that interact with each other. As a consequence, new emergent behaviors, and in many cases surprising, arise. Following the approach of Statistical Mechanics, which successfully interpreted Thermodynamics as the macroscopic (emergent) statistical result of the interaction of a large number of atoms or molecules (microscopic agents), the more general field of Statistical Physics has extended its scope during the 20th Century to include these "complex systems", hence the current name of "Physics of Complex Systems".

For a summary of the master's degree and its contents the following keynote is available: presentation (in spanish).

## OBJECTIVES AND COMPETENCES

Master's program includes a set of training activities aimed at providing a solid postgraduate skills with the following objectives: the initiation to research activities and the academic specialization in the field of Physics of Complex Systems. Two main topics are addressed: systems exhibiting complex temporal or spatio-temporal dynamics, and systems displaying emergent properties as the level of complexity increases.

It is expected that graduated students will achieve the following skills:

- To develop and apply their own original ideas within the context of research. For that purpose they must broaden their previous foundation in physics and gain a specialized knowledge in specific aspects of the Physics of Complex Systems such as: the different levels of description of physical phenomena (microscopic, mesoscopic and macroscopic), the qualitative properties of the dynamics equations and their dependence on parameters, the importance of noise and fluctuations, and the relationship between the microscopic elements of a system, their interactions and the system geometry, with the macroscopic properties.

- To apply the knowledge achieved to solve practical problems both in the academic and professional domain. This will be accomplished by improving their capabilities in modeling and simulation, as well as their experimental skills, in aspects related to the construction of numerical models, the design of experimental systems, and the knowledge of the properties and microscopic structure of solid materials and fluids.

## CAREER OPPORTUNITIES

This master is not focused on professional practice. Master's program is highly focused on research and academic specialization. Main professional outings include teaching and professional research in public and private organizations. The research-based approach followed in the master may facilitate access to professional outings with a research profile in the industry.

The study of complex systems is not only part of basic science and research, but it is also part of applied areas of innovation in a wide variety of fields. As examples we can mention: the study and decoding of the human genome, the analysis and prediction of the evolution of indicators and economic (Stock Market, macroeconomic data) or industrial variable (electrical or water consumption), the design and manufacture of new materials (for the semiconductor industry, plastics and polymers, etc.) or the study of meteorology and the global ocean dynamics. We can also cite the field of complex fluids as one of the most active ones in the demand for researchers in the industry. Indeed, the relationship between microscopic structure and macroscopic dynamics achieves utmost relevance in every industrial process involving polymeric fluids, emulsions, suspensions or interfacial processes. From this perspective, this program is aimed at training researchers in methods for studying complex systems and their scientific and technological applications. Furthermore, since the study of complex systems involves topics that traditionally and academically belonged to different fields, the master program has a strong interdisciplinary nature.

## ACCESS PREREQUISITES

The Master's Degree in Physics of Complex Systems is in the process of extinction since the academic year 2021/2022, so it does not admit new students. See section "Sobre la extinción del título" for more information. UNED degree catalog offers alternatives to this master's degree (see Master Degree in Advanced Physics).

## ADMISSION CRITERIA

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## NUMBER OF NEW STUDENTS

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## CURRICULUM

Type of course	First semester	Second semester
Compulsory	Introduction to Nonlinear Science	
	Fluctuations in Dynamical Systems	Advanced Numerical Methods
	Selective	Advanced Statistical Mechanics
Neural Networks and Complex Networks	Statistical Mechanics of Complex Fluids	Transport Phenomena: Simulation Techniques in Fluids
Physics of Continuous Media: General Formalism and Applications	Instabilities and Turbulence	Compressible Fluid Dynamics
Microscopic Processes in Condensed Matter	Density Functional Theory: Electronic Systems	Modelization and Simulation of Complex Systems
Electronics	Sociophysics and Social Networks	Compulsory

### Distribution of ECTS by type of credit

Type	ECTS
Compulsory.....	18
Selective.....	30
Master's Thesis.....	12
<b>Total.....</b>	<b>60</b>

European credits ECTS stand for a measure of the workload needed to complete the program of studies. One ECTS represents 25 hours of study, although the number of hours required a week may vary throughout the course. Before enrollment, it is convenient to estimate the daily time available to prepare the courses according to these measures.

## RULES

- RD 822/2021, de 28 de septiembre, Organización de las Enseñanzas Universitarias
- Normas y criterios generales de reconocimiento y transferencia de créditos para los másteres.
- Normas de permanencia en estudios conducentes a títulos oficiales de la Universidad Nacional de Educación A Distancia.
- Regulación de los trabajos de fin de master en las enseñanzas conducente al título oficial de master de la UNED.

## PRACTICES

Given the academic and research nature of the master's degree, and taking into account the profile of the UNED students, who generally combine their studies with work life, no external internships are expected.

The only practical part of the Master is the Master's Thesis (TFM). During the TFM the student will be supervised by a tutor.

### TFM Guidelines

Master's professors will propose different topics for the TFM.

Each student will be assigned a TFM. This assignment will be carried out trying to balance the offer of TFM matters proposed by the Master's professors and the demand of TFMs from the students.

The TFM can be defended provided the student has passed the remaining courses (48 ECTS).

The defense of TFM must be public and before a committee made up of 3 faculty members/researchers. The defense must be in person at the Faculty of Sciences or through webconference from an Associated Center of the UNED .

## OFFICIAL DOCUMENTATION

It is required by law that all universities submit their official degrees for a verification, monitoring and accreditation process.

In the case of the UNED, the Council of Universities receives the memory of the degree and sends it to the National Quality Agency (ANECA) for its evaluation and issuance of the Verification Report. If the report is favorable, the Council of Universities dictates the Resolution of Verification, and the Ministry of Education submits to the Government the

official proposal of the degree, orders its inclusion in the Registry of Universities, Centers and Degrees (RUCT) and its subsequent publication in the Official State Gazette.

Official master's degrees must renew their accreditation before four years from their verification or from the date of their last accreditation, in order to check whether the results obtained are adequate to guarantee the continuity of their teaching. If they are adequate, the Council of Universities issues a Resolution accrediting the degree.

These resolutions and reports are recorded in the Registry of Universities, Centers and Degrees (RUCT).

Official documentation (in Spanish)

### **VERIFICACIÓN / MODIFICACIÓN**

- Memoria del Título
- Informe de Verificación de la ANECA
- Resolución de verificación del CU
- Inscripción del Título en el Registro de Universidades, Centros y Títulos
- Publicación del Plan de Estudios en el BOE
- Informe/s de modificación del Plan de Estudios

### **SEGUIMIENTO**

- Informe de seguimiento del título

### **ACREDITACIÓN**

- Informe de renovación de la acreditación 2014
- Resolución de acreditación del CU 2015
- Informe de renovación de la acreditación 2019
- Resolución de acreditación del CU 2019

## **INTERNAL QUALITY ASSURANCE SYSTEM FOR THE TITLE**

The UNED has an Internal Quality Assurance System (SGIC-U) that covers all its official undergraduate, master and doctorate degrees, as well as the services it offers, the design of which was certified by the Spanish National Quality Agency ANECA.

The SGIC-U includes all the processes necessary to ensure the quality of its teaching staff, resources and services for students: access, admission and reception, external internships, mobility programs, academic orientation and job placement, monitoring and evaluation of training results, attention to suggestions and complaints and the adequacy of support staff, among others.

The members of the SGIC are:

- The Degree Coordinating Committee

- The Center's Quality Assurance Committee
- The Dean or Director Team
- The UNED Quality Assurance Committee

Through the Statistical portal, the UNED provides information to the entire university community both on the training results and on the satisfaction results of the different groups involved.

SGIC documents (in spanish):

- Principales resultados de rendimiento
- Resultados de satisfacción de los diferentes colectivos
- Calidad en el Centro

## PROFESSIONAL ATTRIBUTIONS

This master does not give access to regulated professions.

## COMISION COORDINADORA DEL MASTER

- Ángel Maroto Valiente (President of the Coordinating Committee),
- Jaime Arturo de la Torre Rodríguez (Coordinator of the Master Program),
- Pedro Córdoba Torres (Secretary of the Master Program),
- Emilia Crespo del Arco (Departamento de Física Fundamental),
- Elka Korutcheva (Departamento de Física Fundamental),
- Víctor Fairén Le Lay (Departamento de Física Interdisciplinar),
- Belén Gallardo Almela (Administrative staff),
- Jesús López Santiago (Student).

Contact: ciencias.posgradosoficiales@adm.uned.es

## QUIERO MATRICULARME EN EL MASTER

### PRE-REGISTRATION / ADMISSION

**All students who wish to enroll for an Official Master's Degree at UNED must make an application for admission on the UNED website [www.uned.es](http://www.uned.es). Search and consult the UNED page:**

### Masteres Universitarios EEES

**for detailed information on pre-registration and enrollment deadlines.**



Students with a non-homologated foreign degree must request, prior to pre-registration, the authorization of the Rector to study in the university, and according to the established procedure.

## **SOBRE LA EXTINCIÓN DEL TÍTULO**

At the Faculty Meeting held on March 15, 2021, it was ratified the extinction of the Master's Degree in Physics of Complex Systems (MFSC), approved at the meeting of the Academic Committee of the Master's Degree held on March 4, 2021.

The beginning of the extinction of the master will take place in the academic year 2021/22, and will coincide with the implementation of the new Master in Advanced Physics (MFA), as foreseen in the Verification Report of this master. This means that new students will no longer be allowed to enroll in the MFSC from the academic year 2021/22 (inclusive).

Regarding the situation of students who have already started their studies in the MFSC, there are two main alternatives:

1. They will be able to continue their studies and therefore enroll in the remaining courses until the end of the course, in accordance with the following conditions:

- The regulations guarantee that during the two academic years following the beginning of the extinction of the master's degree (academic years 2021/22 and 2022/23), the tutoring of the subjects and the evaluation process will continue to be carried out normally.
- The regulations also establish that a student can be enrolled in a master's degree for a maximum of 4 years, with the possibility of 1 additional year if he/she takes advantage of the grace period, plus an extra year if only the Master's Thesis is pending and the additional grace period is granted. This makes a maximum of 5+1 years. Within this period, the student may continue to enroll and will be guaranteed the evaluation as it has been developed, but beyond the two initial courses mentioned above, there will be no attention or tutoring by the faculty. For example, if a student enrolled for the first time in the academic year 2019/20, he/she can continue to enroll in the ordinary way until the academic year 2022/23, apply for the grace call during the academic year 2023/24, and the additional grace call in the academic year 2024/25 (if only the TFM remains). However, you will only receive tutoring during the academic years 2021/22 and 2022/23.

2. Students will be able to transfer at any time they wish to the new MFA master's degree.

Regarding this option, please note the following:

- The new MFA inherits approximately 50% of the subjects of the old MFSC, so if a student of the MFSC has taken some of those subjects and wants to transfer to the new master, those subjects will be recognized directly in the new master as passed (with the grade already obtained).
- In the case of subjects that do not have counterparts in the new master's degree, a recognition of competencies will be carried out. This procedure consists of comparing the

competencies acquired in the subjects of the old master's degree with the competencies foreseen in the subjects of the new master's degree. In the case of finding two subjects with equivalent competencies, one will be recognized for the other.

- In those cases in which there is no coincidence in content or competencies, as well as for any other problem that may arise from the request for transfer of a transcript, the Academic Committee of the new MFA will be the body in charge of articulating the corresponding procedure.

It is expected that the transfer mechanism will be agile and flexible. For any questions regarding administrative procedures, please contact: `ciencias.posgradosoficiales@adm.uned.es`

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## GENDER EQUALITY

Consistent with the assumed value of gender equality, all the denominations that in this Guide refer to single-person, representative, or members of the university community and are made in the masculine gender, when they have not been replaced by terms generic, shall be understood as interchangeably in female or male gender, depending on the sex of the holder who performs them.