



Asignatura: Neurociencia y Biología de Sistemas
Código: 31208
Centro: Facultad de Ciencias
Titulación: Máster en Biofísica
Nivel: Máster
Tipo: Obligatoria
Nº de créditos: 6 ECTS

ASIGNATURA / COURSE TITLE

Neurociencia y Biología de Sistemas / Neuroscience and Systems Biology

1.1. Código / Course number

31208

1.2. Materia / Content area

Física, Biología, Matemáticas / Physics, Biology, Mathematics

1.3. Tipo / Course type

Obligatoria / Compulsory

1.4. Nivel / Course level

Máster / Graduate (postgraduate program)

1.5. Curso / Year

1º / 1st

1.6. Semestre / Semester

2º / 2nd

1.7. Número de créditos/ Credit allotment

6 ECTS / 6 ECTS

1.8. Requisitos previos/ Prerequisites

The students should have attended and passed the subjects of the first semester of the Biophysics Master, or credit equivalent knowledge from other postgraduate courses.

1.9. Requisitos mínimos de asistencia a las sesiones presenciales / Minimum attendance requirement

Minimum attendance for theory and practical lectures: 80%. Attendance to seminars is highly recommended but optional.



Asignatura: Neurociencia y Biología de Sistemas
Código: 31208
Centro: Facultad de Ciencias
Titulación: Máster en Biofísica
Nivel: Máster
Tipo: Obligatoria
Nº de créditos: 6 ECTS

1.10. Datos del equipo docente/ Faculty data

Raúl Guantes

(subject coordinator)

Department: Condensed Matter Physics and
Institute for Materials Sciences 'Nicolás Cabrera'.
Faculty: Ciencias.
Office: Módulo 08, 114
Teléfono: + 34 91 497 8735
E-mail: raul.guantes@uam.es
Página Web: <http://www.uam.es/raul.guantes>

1.11. Objetivos del curso/ Course objectives

Offer a physiological and computational perspective on nervous and cellular systems and the way they process sensory, environmental or signaling information. A main goal is to achieve an integrative view of general biological networks (at neuronal, genetic, protein and population levels) linking structure and function, highlighting design and optimization principles, and investigating their organization in simpler modules or functional units.

- The students will learn and employ theoretical tools such as dynamical systems theory, stochastic processes, complex network analysis, information and optimization, etc., with emphasis on the application of such tools to different biological contexts and the synergic use of experimental and theoretical approaches.

- Contenidos del programa/ Course contents

Neuroscience:

1. Basic concepts in Neuroscience. Membrane potential, resting potential, post-synaptic potential and action potential.
2. Neuron models. The Hodgkin-Huxley current. The integrate-and-fire model. Cortical networks.
3. Memory. Working memory. Associative memory. Attractor dynamics. Long-term potentiation. The role of NMDA receptors in LTP.
4. Variability and the neural code. The firing rate code and temporal codes.

Systems Biology:

1. Dynamical systems in Biology. Modules in biological networks: genetic switches and oscillators. Noise in gene expression. Cell decisions.
2. Non linear dynamics in cell signalling networks and biological pattern formation. Cell dynamics in response to drug treatment.



Asignatura: Neurociencia y Biología de Sistemas
Código: 31208
Centro: Facultad de Ciencias
Titulación: Máster en Biofísica
Nivel: Máster
Tipo: Obligatoria
Nº de créditos: 6 ECTS

3. Population ecology and evolution. Game theory in microorganisms: conflict and cooperation.
4. Information transmission and optimization in regulatory networks.
5. Collective behavior.

1.12. Referencias de consulta / Course bibliography

Recommended textbooks:

- P. Dayan and L. Abbott, Theoretical Neuroscience, MIT Press, 2001.
- S. Strogatz, Nonlinear dynamics and chaos, Addison-Wesley, 1994.
- Fall et al, Computational cell biology, Springer, 2002.
- U. Alon, An introduction to systems biology. Chapman and Hall CRC, 2007.
- Neuroscience. Exploring the Brain. Bear, Connors y Paradiso. Williams and Wilkins, 1996

2. Métodos docentes/ Teaching methodology

1. Theory lectures: Oral presentations by the teachers of the fundamental contents of the subject. Audiovisual material will be available for the students in the Master web page, or in the personal web pages of lecturers.
2. Practical lectures: Problems solution, practical exercises to be programmed by the students in the computers room assisted by teachers.
3. Labs: Non-linear chemical reactions and Turing patterns.
4. Group discussions: Discussion of research papers proposed by the teachers.
5. Advanced seminars: Monographic sessions by invited researchers on some specific aspect related to the subject, with emphasis on the current state of the art.

3. Tiempo de trabajo del estudiante / Student workload

		Nº de horas	Porcentaje
Personal attendance	Theory clases	40	40%
	Practical clases	6	
	Group discussion	6	
	Seminars	8	
No attendance	Preparation of practical exercises, exam and papers discussions.	90	60%
Total		150 h	100%



Asignatura: Neurociencia y Biología de Sistemas
Código: 31208
Centro: Facultad de Ciencias
Titulación: Máster en Biofísica
Nivel: Máster
Tipo: Obligatoria
Nº de créditos: 6 ECTS

4. Métodos de evaluación y porcentaje en la calificación final / Evaluation procedures and weight of components in the final grade

Systems Biology part: Individual reports of solved practical exercises proposed by the teachers(35 %). Group discussion of research papers under teachers guidelines: 15 %. Neuroscience part: Exam (50 %).
In the extraordinary evaluation session the students will have the possibility to surpass the practical exercises from the Systems Biology part (50%) or the Neuroscience exam (50%).

5. Cronograma* / Course calendar

Semana aprox. Week	Contenido Contents	Horas presenciales Contact hours	Horas no presenciales Independent study time
1-4	Theory lectures (Neuroscience and Systems Biology)	40	10
5	Advanced seminars	8	0
6	Practical lectures	6	30
7	Group discussions	6	20

*Este cronograma tiene carácter orientativo.