Asignatura: Métodos Avanzados de Física y Matemáticas en Biofísica
Código: 30120
Centro: Facultad de Ciencias
Titulación: Máster en Biofísica
Nivel: Máster
Tipo: Optativa
Nº de créditos: 10 ECTS

ASIGNATURA / COURSE TITLE

Métodos Avanzados de Física y Matemáticas en Biofísica / Advanced Methods in Physics and Mathematics

1.1. Código / Course number

30120

1.2. Materia / Content area

Física, Biología, Matemáticas / Physics, Biology, Mathematics

1.3. Tipo / Course type

Asignatura de nivelacion, obligatoria para alumnso con grado en ciencias biologicas / Compulsory for students with degrees on biological sciences

1.4. Nivel / Course level

Posgrado / Graduate (postgraduate program)

1.5. Curso / Year

1º / 1st

1.6. Semestre / Semester

2º / 1st

1.7. Número de créditos/ Credit allotment

10 ECTS / 10 ECTS

1.8. Requisitos previos/ Prerequisites

None.

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.

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1.10. Datos del equipo docente/ Faculty data

Pedro Tarazona
(subject coordinator)

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1.11. Objetivos del curso/ Course objectives

This is a "put on level" course for students joining the Master in Biophysics from degrees on biological or medical sciences. A main goal of the course is to achieve or "refresh" the mathematical abilities needed to follow other courses . The second main aspect is the introduction to the physics concepts and techniques that are used both in theoretical and experimental subjects in the Master.

The course is run on a tutorial basis, with the contents and level adapted to the needs of the students, and giving them a running support for the particular items that might be difficult to them, along the other courses. The overall goal of the course is not to achieve a level in physics and mathematics equivalent to that of the students coming from degrees in physics, but rather to teach the students with a background in bio-sciences how to open "dialog channels" with physicists.

- Contenidos del programa/ Course contents

Mathematics:

1. **Elementary calculus:** Functions, derivatives, Taylor expansions, integrals, algebraic equations, complex numbers and complex functions.
2. **Differential equations:** First and second order LDE, general solution and initial values, inhomogeneous LDE. Linearization of ordinary differential equations.
3. **Vector calculus:** Spatial coordinates, vectors, scalar and vector fields, differential operator, gradient, divergence, rotational and laplacian.
4. **Fourier analysis:** Fourier series and transforms. Analysis of signals.
5. **Partial differential equations**: Diffusion eq., wave eq.

Physics:

6. Simple movements: Newtonian dynamics, oscillators, damped oscillators, forced oscillator. Langevin dynamics. Coupled oscillators, normal modes. Mechanical waves.

7. Thermodynamics and Statitical physics: Energy, work and heat, entropy, temperature and free energy. Statistical ensembles, partition functions, mean values and fluctuations. Molecular Dynamics and Monte Carlo simulations.

8. Electromagnetism: Electrical charges and electrical fields. Conductors and insulators. Electrical currents, Ohm's law. Magnetic fields. Induction and electromagnetic effects, AC circuits, electromagnetic waves.

9. Introduction to quantum physics: Quantum states, Heisenberg's principle, electronic orbitals, Pauli's principle.

10. Introduction to experimental physics: Motion, oscillations and waves, thermodynamics and light.

1.12. Referencias de consulta / Course bibliography

Recommended textbooks:

- Claudia Neuhauser, Calculus for biology and medicine. Prentice Hall,2000.
- D.S. Jones and B.D. Sleeman, Differential equations and mathematical biology, Chapman¬Hall/CRC 2003
- Marvin L. Bittinger, Neal Brand, John Quintanilla, Calculus for the life sciences, Addison-Wesley 2006
- Robert M. Eisberg, Fisica Fundamentos y Aplicaciones, NCGraw-Hill, 1986

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. Practical sessions: Realization of several experiments in the physics lab.

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 classes	60	48%
	Practical classes	40	
	Group discussion	12	
	Seminars	8	
No attendance	Preparation of practical exercises and reports	130	52%
Total		**250 h**	**100%**

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

Presentations of solved practical exercises(50%), group discussions(15%), and report on experimental techniques(35%).
Extraordinary call:
Presentation of solved practical exercises(up to 50%). Lab reports (up to 50%).

5. Cronograma* / Course calendar

Semana aprox. Week	Contenido Contents	Horas presenciales Contact hours	Horas no presenciales Independent study time
1 to 12	Lectures, group discussion and seminars	74	74
12 to 14	Lab. practice	26	26

*Since the whole course is given to a reduced group on a tutorial basis, this cronogram is only orientative.