



Asignatura: Análisis de Imagen en Biofísica
Código: 30426
Centro: Facultad de Ciencias
Titulación: Máster en Biofísica
Nivel: Máster
Tipo: Obligatoria
Nº de créditos: 3 ECTS

ASIGNATURA / COURSE TITLE

Análisis de imagen en Biofísica/ [Image Analysis](#)

1.1. Código / [Course number](#)

30426

1.2. Materia / [Content area](#)

Física, Biología, Informática / [Physics, Biology, Informatics](#)

1.3. Tipo / [Course type](#)

Obligatoria / [Compulsory](#)

1.4. Nivel / [Course level](#)

Posgrado / [Graduate \(postgraduate program\)](#)

1.5. Curso / [Year](#)

1º / [1st](#)

1.6. Semestre / [Semester](#)

2º / [2nd](#)

1.7. Número de créditos/ [Credit allotment](#)

3 ECTS / [3 ECTS](#)

1.8. Requisitos previos/ [Prerequisites](#)

Students should have attended and passed the first semester subjects

1.9. Requisitos mínimos de asistencia a las sesiones presenciales / [Minimum attendance requirement](#)

Minimum attendance for theoretical seminars: 80%. Minimum attendance to practical sessions: 80%.



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1.10. Datos del equipo docente/ Faculty data

Sergio Marco
(subject coordinator)

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1.11. Objetivos del curso/ Course objectives

The aim is allow students to understand the content of images obtained through various imaging techniques used in biology (CAT-scan, AFM, photonic, electronic, ionic, etc.) by becoming familiar with the manipulation of digital images, image processing methods and quantitative image analysis. The ultimate goal is that students, through the understanding of images and their generation mechanisms, acquire critical thinking about image contents and artifacts to correctly interpret, extract and quantify the information contained in biological images.

- Contenidos del programa/ Course contents

Basic concepts:

1. Bit, byte, pixel, voxel, image format, image dynamic, image histogram analysis, LUTs, mathematical operation with images.
2. Sampling: Shannon-Whitaker theorem
3. Fourier space, operations in the frequency space.
4. Segmentation, noise types and filters in real and fourier space.
5. Projection and back-projection
6. 3D visualization, use of ImageJ and Fiji, plug-in installation, Macro language.

Image quantification:

1. Densitometry
2. Granulometry

Signal analysis:

1. Periodic signal, 2D crystals, stacks, helix. Computation of parameters from periodic signal: lattice vectors, helical and stack parameters.
2. Signal to noise ratio
3. Denoising

3D reconstruction from projections:



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1. Image alignment procedures: cross-correlation, fiducial markers, free-reference alignment methods, automatic landmarks generation
2. Reconstruction algorithms used in medical imaging and biology: central section theorem, back-projection in Fourier space, weighted back-projection, Algebraic reconstruction techniques, Simultaneous iterative reconstruction techniques.
3. Effects of sampling and missing wedge

Volume rendering and segmentation:

1. Thresholded based segmentation
2. Semi automatic segmentation (TrackEM)

1.12. Referencias de consulta / Course bibliography

Recommended textbooks:

Electron tomography. J Frank. Ed Springer. 2nd edition. ISBN: 0-387-31234-X

Digital image processing. An algorithmic introduction using Java. W. Burger & M.J. Burge. Ed. Springer. ISBN: 978-1-84628-379-6

2. Métodos docentes/ Teaching methodology

1. Group work in computer room: Theoretical concepts are introduced for the whole class and immediately applied in practical exercises on the computer. An example is show by the professor and practical questions needing the use of the introduced theoretical concepts and of the examples should be solved by students. Discussions of the obtained results and applied procedures follow the execution of the exercises
2. Personal training: Each student has a personal interview with a minimal duration of 1h (in general 1h and half) after finishing the entire group work. Specific questions and doubts are solved during this interview.

3. Tiempo de trabajo del estudiante / Student workload

		Nº de horas	Porcentaje
Personal attendance	Theory and classes	40	56%
	Personal training	2	
No attendance	Personal work and exam preparation	33	44%
		75	100%



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

Exam consisting in a theoretical questionnaire (30% of final note) and practical exercises on the computer (70% of final note).

The extraordinary evaluation session will consist of an exam with the same structure and weights than the regular evaluation.

5. Cronograma* / Course calendar

Semana aprox. Week	Contenido Contents	Horas presenciales Contact hours	Horas no presenciales Independent study time
1	Theory and practical lectures	40	0
2	Personal training	2	33

*Este cronograma tiene carácter orientativo.