



COURSE: INTRODUCTION TO BIOMEDICAL IMAGING (15558)

DEGREE: BIOMEDICAL ENGINEERING

YEAR: 2015/2016

TERM: 1st Term

*La asignatura tiene 29 sesiones que se distribuyen a lo largo de 14 semanas. Los laboratorios pueden situarse en cualquiera de ellas.
Semanalmente el alumnos tendrá dos sesiones, excepto en un caso que serán tres*

WEEKLY PLANNING

WEEK	SESSION	DESCRIPTION	GROUPS (mark X)		SPECIAL ROOM FOR SESSION (Computer class room, audio-visual class room)	Indicate YES/NO If the session needs 2 teachers	WEEKLY PROGRAMMING FOR STUDENT		
			LECTURES	SEMINARS			DESCRIPTION	CLASS HOURS	HOMEWORK HOURS (Max. 7h week)
1	1	Intro to Med. Imaging	X			NO	Introduction to Medical Imaging, course objectives, main sections.	1,6	5
1	2	Principles of Light Propagation	X			NO	Principles of light propagation, light absorption and light scattering	1,6	
2	3	Principles of Light Propagation - Light emission	X			NO	Principles of light generation, fluorescence and the laser.	1,6	5
2	4	Intro to Microscopy - Widefield microscopy, inc. basic optics.	X			NO	Introduction to Microscopy	1,6	
3	5	Source of Contrast: Fluorescence, clones	X			NO	Derivation of fluorescence, fluorescence lifetime, quantum yield.	1,6	5
3	6	Imaging: from cells to whole animals	X			NO	Overview of the effect of scattering and how it affects imaging.	1,6	

4	7	LAB SESSIONS (x2)	X		X	NO	Two lab sessions: one building a SPIM microscope, the other imaging and displaying 3D Data.	1,6	5
4	8	Source of Contrast: Biolum, upconv. nano-particles, activatable probes	X			NO	In relation to imaging from cells to whole animals, how sources of contrast can be created in-vivo. Image Guided Surgery.	1,6	
5	9	Intro to wave-vector/Transfer function	X			NO	Introduction to the principles of image formation.	1,6	5
5	10	Optical (Fluorescence) Microscopy - PSF, NA	X			NO	Introduction to fluorescence microscopy, the point spread function and the numerical aperture of a microscope.	1,6	
6	11	Transfer Function and resolution	X			NO	The transfer function and its effect on resolution. Definition of resolution.	1,6	5
6	12	Transfer Function extensions (3D) and limitations (shift inv/linearity...)	X			NO	The transfer function in 3D.	1,6	
7	13	Evanescent waves, TIRF	X			NO	Evanescent waves and their relationship with image formation and the wavenumber. Total Internal Reflection Microscopy.	1,6	5
7	14	Detectors (CCD/sCMOS, photomultipliers) and System Transfer Function	X			NO	Different detection approaches and the system transfer function.	1,6	
8	15	Confocal Microscopy, Raman, FRET/FLIM, MultiPhotonExcitation, Higher Harmonic	X			NO	Advanced microscopy: Confocal, FRET/FLIM, non-linear excitation microscopy.	1,6	5
8	16	Geometrical Optics	X			NO	The specific case of propagating waves and sizes much larger than the wavelength: geometrical optics, lenses, focal points, and focal planes.	1,6	
9	17	OPT	X			NO	Introduction to Optical Projection Tomography, a specific case of geometrical optics.	1,6	5
9	18	Super Resolution Microscopy: STED (prereq. confocal), PALM/STORM(inc.CS,3B)	X			NO	Imaging with sub-wavelength resolution, stimulated emission depletion.	1,6	
10	19	SIM (prereq. 3D Transfer Function), Polarization Imaging, SPIM intro,	X			NO	Super-resolution and introduction to Light Sheet Microscopy	1,6	5
10	20	SPIM - DSLM, Bessel beam, 2 photon, structured illumination	X			NO	Light Sheet Microscopy techniques: basic and advanced.	1,6	
11	21	Visit to the Science park, talk about innovation and technology based companies.	X		X	YES	Innovation and technology based companies.	1,6	5
11	22	Imaging in diffuse media	X			NO	Imaging in whole animals, light diffusion. Diffuse Correlation Spectroscopy, LASCA.	1,6	
12	23	Planar Imaging - Ill posed problems	X			NO	Inverse problems and there non-uniqueness.	1,6	5

12	24	FMT - FMT/XCT, FMT/MRI	X			NO	Hybrid modalities for small animal imaging.	1,6	
13	25	Ultrasound Imaging	X			NO	Basics of ultrasound imaging, sources of contrast and microbubbles.	1,6	5
13	26	Photoacoustics	X			NO	Introduction to photoacoustics, preclinical and clinical perspectives.	1,6	
14	27	Presentation of research projects. Elevator pitch.	X			NO	Research projects presented in groups.	1,6	5
14	28	Advanced Optics: Adaptive Optics, Deformable Mirrors, SLM, Shack-Hartmann, Probing Mechanisms	X			NO	Advanced optics and wave front manipulation.	1,6	
	29	Overview on principles of imaging.	X			NO	Overview of the transfer function, fluorescence and the inverse problem in medical imaging.	1,6	

Subtotal 1 **48,33** **70**

Total 1 (<i>Hours of class plus student homework hours between weeks 1-14</i>)	118,33
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15		Tutorials, handing in, etc						12	
16		Assessment						3	
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18									

Subtotal 2 **3**

Total 2 (<i>Hours of class plus student homework hours between weeks 15-18</i>)	15
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TOTAL (<i>Total 1 + Total 2. <u>Maximum 180 hours</u></i>)	133,33
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