Universidad Carlos III de Madrid
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COURSE: INTRODUCTION TO BIOMEDICAL IMAGING (15558)		
DEGREE: BIOMEDICAL ENGINEERING	**YEAR: 2016/2017**	**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 effectof 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 *(Hours of class plus student homework hours between weeks 1-14)*	118,33	

15		Tutorials, handing in, etc						12	
16		Assessment						3	
17									
18									
							Subtotal 2	**3**	
							Total 2 *(Hours of class plus student homework hours between weeks 15-18)*	15	

TOTAL *(Total 1 + Total 2. Maximum 180 hours)*	**133,33**