Universidad Carlos III de Madrid
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COURSE: INTRODUCTION TO BIOMEDICAL IMAGING (15558)		
DEGREE: BIOMEDICAL ENGINEERING	**YEAR: 2018/2019**	**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 alumno 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. Group work on MRI/PET/CT/Ultrasound	1,6	5
1	2	Introductory discussion on Biomedical project	X			NO	The groups for the biomedical project will be formed, and first ideas shared.	1,6	
2	3	Principles of Light Propagation – no Light emission		X		NO	Principles of light propagation: scattering and absorption	1,6	5
2	4	LAB ROTATION I	X		LAB	NO	Lab rotation, a total of 4 experiments will be completed during the course	1,6	
3	5	Basic optics		X		NO	Waves, frequency, amplitude, interference.	1,6	5
3	6	LAB ROTATION II	X		LAB	NO	Lab rotation, a total of 4 experiments will be completed during the course	1,6	

4	7	Intro to Microscopy - Widefield microscopy, inc. basic optics.		X		NO	Introduction to Microscopy	1,6	5
4	8	LAB ROTATION III	X		LAB	NO	Lab rotation, a total of 4 experiments will be completed during the course	1,6	
5	9	Principles of Light Propagation – Light emission		X		NO	Introduction to fluorescence	1,6	5
5	10	LAB ROTATION IV	X		LAB	NO	Lab rotation, a total of 4 experiments will be completed during the course	1,6	
6	11	Source of Contrast: Fluorescence, clones. Source of Contrast: Biolum, upconv. nano-particles, activatable probes		X		NO	Derivation of fluorescence, fluorescence lifetime, quantum yield. Sources of contrast.	1,6	5
6	12	BIOMEDICAL PROJECT Discussion	X			NO	Discussion on the biomedical project, work on the canvas and SWOT table.	1,6	
7	13	Imaging: from cells to whole animals		X		NO	Overview of the effectof scattering and how it affects imaging. In relation to imaging from cells to whole animals, how sources of contrast can be created in-vivo.	1,6	5
7	14	LAB SESSION: Milk Experiment	X		LAB	NO	Experiment to determine the effect of scattering	1,6	
8	15	Introduction to Molecular Imaging approaches		X		NO	Different molecular imaging modalities and their sources of contrast: MRI, PET, CT, Ultrasound, Optical.	1,6	5
8	16	DATA ANALYSIS	X		LAB	NO	Data analysis of the Milk Experiment, performed with ImageJ	1,6	
9	17	Intro to wave-vector/Transfer function		X		NO	Introduction to the principles of image formation.	1,6	5
9	18	TALK Group 1, TALK Group 2	X			NO	Presentations of Groups 1 and 2 on a topic related to their biomedical imaging project	1,6	
10	19	Intro to Wave vector. The Transfer Function and resolution		X		NO	Definition of wavevector. The transfer function and its effect on resolution. Definition of resolution.	1,6	5
10	20	TALK Group 3, TALK Group 4	X			NO	Presentations of Groups 3 and 4 on a topic related to their biomedical imaging project	1,6	
11	21	Confocal Microscopy, Raman, FRET/FLIM, MultiPhotonExcitation, Higher Harmonic		X		NO	Advanced microscopy: Confocal, FRET/FLIM, non-linear excitation microscopy.	1,6	5
11	22	Detectors (CCD/sCMOS, photomultipliers) and System Transfer Function	X			NO	Different detection approaches and the system transfer function.	1,6	
12	23	Evanescent waves, TIRF		X		NO	Evanescent waves and their relationship with image formation and the wavenumber. Total Internal Reflection Microscopy.	1,6	5
12	24	Geometrical Optics	X			NO	The specific case of propagating waves and sizes much larger than the wavelength: geometrical optics, lenses,	1,6	

							focal points, and focal planes.		
13	25	Imaging in diffuse media. Planar Imaging - Ill posed problems		X		NO	Imaging in whole animals, light diffusion. Diffuse Correlation Spectroscopy. Planar Imaging - Ill posed problems and how they correlate with the Milk Experiment	1,6	
13	26	Ultrasound Imaging	X			NO	Basics of ultrasound imaging, sources of contrast and microbubbles.	1,6	5
14	27	Presentation of research projects. Elevator pitch.		X		NO	Biomedical projects presented in groups. An elevator pitch will be presented first (1 minute per group) and then 20 minutes each group for the overall project.	1,6	5
14	28	Photoacoustics	X			NO	Introduction to photoacoustics, preclinical and clinical perspectives.	1,6	
	29	Overview on the course 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. <u>Maximum 180 hours</u>)*	**133,33**