

SUBJECT: Techniques of Microscopy		
COORDINATOR: Francisco Javier González Benito		
POSTGRADE: MASTER IN Materials Science and Engineering	ECTS: 6	TERM: 2
Teachers: Beatriz Galiana Blanco, Dania Olmos Díaz, Alejandro Várez Álvarez, Fco. Javier González Benito		

SCHEDULE OF THE SUBJECT									
WEEK	SESSION	DESCRIPTION OF THE SESSION CONTENT	GROUP		Indicate necessary space (informatics room, laboratory, etc.	WORK OF THE STUDENT DURING THE WEEK			TEACHER
			1	2		DESCRIPTION	CLASSROOM HOURS	WORKING HOURS Week maximum 7 H	
1	1	Introduction to microscopy as materials characterization techniques	x		Classroom (Presential)	Study of recommended bibliography, read slides and do exercises	1,5	4	Fco. Javier González Benito
2	2	Optical microscopy	x		BB Collaborate (Online synchronous)	Study of recommended bibliography, read slides and do exercises	1,5	4	Fco. Javier González Benito
2	3	Confocal microscopy	x		Classroom (presential)	Study of recommended bibliography, read slides and do exercises	1,5	4	Fco. Javier González Benito
3	4	Practical cases about Confocal microscopy (Session I)	x		Flipped Classroom BB Collaborate (online Synchronous)	Preparation of collaborative work about a research article (in groups) and oral presentation	1,5	6	Fco. Javier González Benito
3	5	Practical cases about Confocal microscopy (Session II)	x		Flipped Classroom BB Collaborate (online Synchronous)	Preparation of collaborative work about a research article (in groups) and oral presentation	1,5	6	Fco. Javier González Benito

3	6	Introduction to the electronic optics. Description of Transmission electron microscope	x		Classroom (presential)	Study of recommended bibliography, read slides and do exercises	1.5	5	Beatriz Galiana
4	7	Image formation in a Transmission electron microscope	x		BB Collaborate (Online synchronous)	Study of recommended bibliography, read slides and do exercises	1,5	5	Beatriz Galiana
4	8	Cinematic and dynamic theory of contrast. Defects contrast in crystalline structures	x		Classroom (Presential)	Study of recommended bibliography, read slides and do exercises	1.5	5	Beatriz Galiana
5	9	Introduction to the electronic microscopy of high resolution. Image calculus	x		BB Collaborate (Online synchronous)	Study of recommended bibliography, read slides and do exercises	1,5	5	Beatriz Galiana
5	10	Introduction to the scanning transmission electron microscopy STEM	x		Classroom (presential)	Study of recommended bibliography, read slides and do exercises	1,5	5	Beatriz Galiana
6	11	EELS and images with contrast in atomic number	x		BB Collaborate (Online synchronous)	Study of recommended bibliography, read slides and do exercises	1,5	5	Beatriz Galiana
	12	TEM Lab I: Observation of deformed samples: Dislocation contrast and defects. Structural analysis (Electron Diffraction diagram, X-ray fluorescence spectrum	x		LABMET (Presential)	Preparation of results report related to the practical cases	1,5	6	Beatriz Galiana
	13	TEM Lab II. High resolution electron microscopy (Obtaining and analyzing images). Simulation diffraction	X		LABMET (Presential)	Preparation of results report related to the practical cases	1,5	6	Beatriz Galiana

		diagrams. Z contrast images							
	14	Introduction to the scanning electron microscopy. Description of the scanning electron microscope. detectors	X		Classroom (Presencial)	Study of recommended bibliography, read slides and do exercises	1,5	5	Alejandro Várez
7	15	Image formation in SEM. Other methods of contrast	X		BB Collaborate (Online synchronous)	Study of recommended bibliography, read slides and do exercises	1,5	5	Alejandro Várez
10	16	Introduction to X-Ray microanalysis. X-Ray generation and measurement (detectors) geometric aspects.	X		Classroom (Presencial)	Study of recommended bibliography, read slides and do exercises	1,5	5	Alejandro Várez
11	17	Qualitative analysis. Spectral artifacts. Quantitative analysis. Methods of correction	X		BB Collaborate (Online synchronous)	Study of recommended bibliography, read slides and do exercises	1,5	5	Alejandro Várez
	18	Lab SEM-I. Obtaining images at high vacuum. Basics operations of alignment, contrast and brightness. Handling of different electrons.	X		Laboratory of scanning electron microscopy (presential)	Preparation of results report related to the practical cases		5	Alejandro Várez
	19	Lab SEM-II. Obtaining images of insulator samples. Obtaining images at low vacuum.	X		Laboratory of scanning electron microscopy (presential)	Preparation of results report related to the practical cases		5	Alejandro Várez
	20	Lab EDS.- Obtaining X-ray spectra. Geometrical aspects. Detecting spectral artifacts.	X		Laboratory of scanning electron microscopy (presential)	Preparation of results report related to the practical cases		5	Alejandro Várez

7	21	Scanning Tunneling Microscopy, STM	X		Classroom (Presential)	Study of recommended bibliography, read slides and do exercises	1,5	5	Agustina Asenjo
8	22	Atomic Force Microscopy (AFM). Main operation modes and instrumentation	X		BB Collaborate (Online synchronous)	Study of recommended bibliography, read slides and do exercises	1,5	5	Dania Olmos
9	23	Practical issues of the AFM	X		Classroom (Presential)	Study of recommended bibliography, read slides and do exercises	1,5	4	Dania Olmos
10	24	Electric and Magnetic Field Microscopies	X		BB Collaborate (Online synchronous)	Study of recommended bibliography, read slides and do exercises	1,5	5	Dania Olmos
13	25	Lab AFM I. Introduction to the Atomic Force Microscopy contact and tapping modes.	X		Laboratory of Atomic Force Microscopy (Presential)	Preparation of results report related to the practical cases	1,5	5	Dania Olmos
14	26	Lab AFM II. AFM with control of temperature.	X		Laboratory of Atomic Force Microscopy (Presential)	Preparation of results report related to the practical cases	1,5	5	Dania Olmos
15	27	Lab AFM III. Mechanical characterization by AFM.	X		Laboratory of Atomic Force Microscopy (Presential)	Preparation of results report related to the practical cases	1,5	5	Dania Olmos
11	28	Infrared, Raman and Fluorescence microscopies	X		Classroom (Presential)	Study of recommended bibliography, read slides and do exercises	1,5	4	Fco. Javier González Benito
TOTAL HORAS							42	138	

Subject	PRESENCIAL				ONLINE Synchronous	
	Nº of Presential Groups		Presential Hours		Nº online Groups	Online Hours
	Theory	Laboratory	Theory	Laboratories	Teoría	Teoría
Techniques of Microscopy 6ECTS Compulsory 2T	1 2.3.A02 2.3.A03 2.3A04	10 (2 students each; with social security distance and PPE's) <i>Laboratories of the Department CIMIQ: 1.SA03 y 1.SA01 and the laboratory of the Physics Departament: LAMEB</i>	15h (50%)	12h (x 10 grupos)	1	15h (50%)