CODE	NAME OF MODULE	TYPE
	MOLECULAR MOTIONS IN COMPLEX SYSTEMS	E

M = mandatory
E = elective

3.3.1. Learning goals of the module.

(List the specific learning goals that the current module should provide to the student; goals can focus on content, skills, or attitudes.)

The main goal of the course is to provide a general overview on the most relevant features of molecular motions in soft-matter based systems, covering a wide range of characteristic times and lengths, from microscopic to mesoscopic scales. More specifically, the course offers an introduction to the key concepts and most relevant theoretical approaches describing these phenomena.

3.3.2. Methodology: learning activities and credit value of the module (ECTS).

3.3.2.1. Learning activities.

(Time required to teach the module; links to other modules included in the MSc Program and suggested chronological sequence with the latter)

This is a 3 ECTS module with a classroom lecture time of 30 hours. Half of the lecture time will consist of meetings of discusion between the students and the teacher. The module also includes 45 hours of personal work by the student, which will be dedicated to the preparation of the discussion meetings and to exercises on computer simulation of soft matter-related problems.

3.3.2.2. ECTS credit value (and time)

1 ECTS credit = 25 hours UPV/EHU

TYPE OF LECTURE[1]	Theory		Practice							Evaluation	
	M[2]	S	PA	PL	PO	TA	TAI	PCL	PCC	Periodic Grading	Final Grading
Classroom lectures	0.6		0.6							50 %	
Personal work [3]	0.4		0.6		0.8					50 %	
TOTAL	1.0		1.2		0.8					100 %	

(1) M (standard lecture); S (seminar); PA (practical exercises in classroom); PL (practical exercises in laboratory); PO (practical exercises with computers); TA (non-industrial workshops); TAI (industrial workshops); PCL (clinical practice); PCC (field practice); the acronyms are taken from the Spanish wording.

(2) M = maximum allowed is 60% of the full classroom lectures .

(3) Personal work = time that the student would use to prepare and develop individual and group assignments.

3.3.2.3. Module Program.

(Lectures)

Lecture 0	A BRIEF REVIEW OF PREVIOUS CONCEPTS Correlation functions Relaxation techniques Scattering techniques Computer simulations
Lecture 1	LOCALIZED MOTIONS Rotation of side groups Quantum tunnelling Two-level systems Boson peak Johari-Goldstein process
Lecture 2	THE GLASS TRANSITION: GENERAL CONCEPTS The problem of the glass transition The Kauzmann paradox Fragility an dynamic arrest Aging and rejuvenation Dynamic heterogeneity
Lecture 3	THE GLASS TRANSITION: THEORETICAL APPROACHES Adam-Gibbs theory Free volume Energy landscape Mode coupling theory Dynamic facilitation Other approaches
Lecture 4	COLLOIDS AND GELS Jamming and gelation Connections with glass-formers Clustering and bond percolation Arrested phase separation
Lecture 5	CHAIN DYNAMICS IN POLYMER SYSTEMS Rouse and Zimm models Entanglement and reptation models Beyond reptation models
Lecture 6	DYNAMICS IN COMPLEX SYSTEMS Confinement Polymer blends and complex mixtures Complex structures of block copolymers Ultrasoft particles Dynamics in external fields

3.3.2.4. Bibliography.

(Basic and specialized bibliographies, journal references, internet addresses, etc.)

"Metastable liquids". P.G. Benedetti. Princeton University Press (1996).

"Glassy materials and disordered solids". K. Binder and W. Kob. World Scientific (2005).

"The theory of polymer dynamics". M. Doi and S. F. Edwards. Oxford University Press (1986).

"Tube theory of entangled polymer dynamics". T.C.B. McLeish, Advances in Physics 51, 1379-1527 (2002).

"Colloidal gels: equilibrium and non-equilibrium routes". E. Zaccarelli, Journal of Physics: Condensed Matter 19, 323101(1-50) (2007).

3.3.3. Criteria and methods for evaluation and grading

(Analysis of the methodology that will be used to evaluate the learning process of the student)

Continuous evaluation on the basis of the aforementioned discussion meetings and exercises. Evaluation also includes periodic personalized meetings for each student.

3.3.4. Learning resources

The student will have free access to the libraries of the UPV/EHU, CFM, and DIPC foundation, to on-line scientific journals, and to available resources for computer simulation in the CFM.

3.3.5. Language and number of groups attending the module

1	NUMBER OF GROUPS
x	LANGUAGE: ENGLISH

3.3.6. Fields of science and technology to which the module is related

CODE	FIELD
2204.99	PHYSICS OF FLUIDS: GLASS TRANSITION
2211.23	SOLID STATE PHYSICS: NON-CRYSTALLINE STATES
2210.25	CHEMICAL PHYSICS: RELAXATION PROCESSES
2206.03	MOLECULAR PHYSICS: MACROMOLECULES
2204.01	PHYSICS OF FLUIDS: COLLOIDS

3.3.7. Department in charge of the Program

CODE	DEPARTMENT [1]
	DEPARTAMENTO DE FISICA DE MATERIALES

3.3.8. Teachers in charge of the module

DNI	Teacher UPV/EHU	Number of credits

DNI	Teacher other institutions	Number of credits
20171866S	ANGEL JOSE MORENO SEGURADO (CFM-CSIC)	3