UNIVERSIDADE DA CORUÑA

Teaching Guide			
Identifying Data			2023/24
Subject (*)	Thermo-mechanical properties of materials. Fundamental Methods	Code	730495003
Study programme	Mestrado Universitario en Materiais Complexos: Análise Térmica e Reoloxía (plan 2012)		

Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	2nd four-month period	First	Obligatory	4

Language	English		
Teaching method	Face-to-face		
Prerequisites			
Department	Enxeñaría Naval e Industrial		
Coordinador	López Beceiro, Jorge José	E-mail	jorge.lopez.beceiro@udc.es
Lecturers	López Beceiro, Jorge José Pereira Rodríguez, Mercedes	E-mail	jorge.lopez.beceiro@udc.es mercedes.pereira@udc.es
Web			
General description	This course presents the thermal properties of materials (glass transition, relaxation mechanisms, phase transitions, thermal stability) and experimental techniques to study (dielectric analysis, thermomechanical, thermogravimetry, differential scanning calorimetry).		

Study programme competences / results	
Code	Study programme competences / results
A1	Set up and conduct tests using the techniques of thermal analysis and rheology most appropriate in each case, within the scope of complex materials
A2	Identify and evaluate the different types of complex materials
B1	Knowledge and understanding to provide a basis or opportunity for originality in developing and / or applying ideas, often in a research context
B2	The students have the skill to apply their knowledge and their ability to solve problems in new or unfamiliar contexts within broader (or multidisciplinary) contexts related to their field of study
B4	That the students can communicate their conclusions and the knowledge and last reasons behind that conclusions to specialized and non specialized audience in a clear and unambiguous way
B8	Applying a critical, logical and creative way of thinking
B13	Analysis-oriented attitude
B21	To assess the importance of research, innovation and technological developments in the socio-economic and cultural progress of society
C2	Have a good command of spoken and writing expression and understanding of a foreign language.
C6	Critically assessing the knowledge, technology and information available to solve the problems they face with.
C7	To assume as a professional and citizen the importance of learning throughout life.
C8	To assess the importance of research, innovation and technological development in the socio-economic and cultural progress of society.
C9	Appreciate the importance of research in environmental protection

Learning outcomes			
Learning outcomes	Study programme competences / results		
To know the different thermal transformations may experience a material	AR2	BR1 BR2 BR8 BR21	CR2 CR7 CR8 CR9

To identify different thermal transformations using different experimental techniques	AR1 AR2	BR1 BR2 BR4 BR8 BR13 BR21	CR2 CR6 CR7 CR8
To Set up properly the tests	AR1	BR2 BR13	CR8
To know the possibilities of separation of overlapped processes	AR1	BR1 BR2 BR13	

Contents	
Topic	**Sub-topic**
The glass transition and other relaxation processes	Transitions of first and second order. Relaxation processes in polymers. The complexity of the glass transition.
Melting and softening observed by DSC, DEA and rheology	Amorphous and crystalline polymers. Melting and softening. Differential scanning calorimetry Dielectric analysis Thermomechanical analysis Observed by DSC, DEA and TMA
Curing processes	Curing: Chemical Crosslinking Observation of cure by DSC, DEA and DMA.
Thermal stability by TG	Thermogravimetric analysis. Methods for evaluating the thermal stability Applications

Planning				
Methodologies / tests	**Competencies / Results**	**Teaching hours (in-person & virtual)**	**Student?s personal work hours**	**Total hours**
Guest lecture / keynote speech	A2 B1 B2 B13 B21 C6 C7 C8 C9	10	25	35
Laboratory practice	A1 B1 B2 B13 C8	12	21	33
Supervised projects	A1 B1 B2 B4 B8 B13 B21 C2 C6 C7 C8 C9	2	24	26
Objective test	A1 A2 B2 B4 B13	1	2	3
Personalized attention		3	0	3
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	**Description**
Guest lecture / keynote speech	Presentation given by the professor, on a schematic basis, focusing on the main topics, covering both theoretical and practical issues.
Laboratory practice	Performance of practical activities such as demonstrations, exercises, experiments, etc..
Supervised projects	Activities whose purpose is that the students enlarge the study of the topics pesented in the program and consolidate their acquired knowledge and capabilities. These activities should also help the students learn and improve their capabilities in literature survey.
Objective test	Exam that will help to evaluate the knowledge and competencies acquired by the students.

Personalized attention	
Methodologies	**Description**
Supervised projects Guest lecture / keynote speech Laboratory practice Objective test	The personalized attention to students, understood as a support in the teaching-learning process, will take place in the hours of tutoring of the teacher.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Supervised projects	A1 B1 B2 B4 B8 B13 B21 C2 C6 C7 C8 C9	Presentation (oral and written) of the supervised work.	60
Guest lecture / keynote speech	A2 B1 B2 B13 B21 C6 C7 C8 C9	Continuous assessment through monitoring of student work in the classroom, laboratory and / or tutorials.	10
Laboratory practice	A1 B1 B2 B13 C8	Continuous assessment through monitoring of student work in the classroom, laboratory and / or tutorials.	10
Objective test	A1 A2 B2 B4 B13	Examination or objective test.	20

Assessment comments
Students with an academic exemption: They will have to do the mixed test and present a previously agreed work with the professors of the subject. The assessment will be 50% the mixed test and 50% the supervised work. The mixed test may include questions related to the contents addressed in any of the sessions, whether theoretical, practical or during the debates that occur in the presentations of works. To pass the subject, a minimum score of 4 (on a scale of 0 to 10) in the mixed test is required. The evaluation criteria of the 2nd opportunity are the same as those of the 1st opportunity. If the student did not carry out the laboratory practices, nor did he solve the problems raised, the mixed test will include questions related to these aspects, increasing the assessment of this methodology. The student must present a work previously agreed with the professors of the subject. The evaluation criteria for the extraordinary call are the same as those for the 1st opportunity. If the student did not carry out the laboratory practices, nor did he solve the problems raised, the mixed test may include additional questions related to these aspects, increasing the assessment of this methodology. The student must present a work previously agreed with the professors of the subject. The fraudulent completion of exams or evaluation activities, once confirmed, will directly result in a failing grade in the session in which it occurs: the student will be awarded a 'fail' (numerical grade of 0) in the corresponding academic year session, whether the offense is committed during the first opportunity or the second. To this end, their grade will be modified in the first opportunity transcript, if necessary.

Sources of information	
Basic	The UDC Library system allows to search online for recommended literature by professor and by subject. This is an expanded list of recommended sources of information:Mechanical properties of polymers and composites / Lawrence E. Nielsen, Robert F. Landel Nielsen, Lawrence E. Esc Politécnica Superior -- CM P 154 -- VENCE 06-06-16 Thermal analysis. Fundamentals and applications to materialcharacterization: proceedings of the international seminar: Thermal analysisand rheology. Ferrol, Spain, 30Juny-4 July, 2003 / Ramón Artiaga Díaz (ed.), A Coruña: Universidade da Coruña,Servicio de Publicacions, 2005, ISBN 84-9749-100-9Thermal analysis of polymers / edited by Joseph D. Menczel, R. Bruce Prime; Hoboken, N.J.: JohnWiley, [2009], ISBN 978-0-471-76917-0Thermal characterization of polymeric materials / edited byEdith A. Turi, San Diego : Academic Press, 1997, 2nd. ed. ISBN 0-12-703781-0(v.1) 0-12-703782-9 (v.2)
Complementary	

Recommendations
Subjects that it is recommended to have taken before

Subjects that are recommended to be taken simultaneously
Termomecanics of Materials Properties. Advanced Methods/730495004
Subjects that continue the syllabus
Other comments
To help achieve a sustained immediate environment and meet the objective of action number 5: "Healthy and sustainable environmental and social teaching and research" of the "Green Campus Ferrol Action Plan":The delivery of the documentary work carried out in this subject:They will be requested in virtual format and/or computer supportIf it is necessary to make them on paper:- Plastics shall not be used- Double-sided printing shall be carried out.- Recycled paper will be used.- Printing of drafts shall be avoided.A sustainable use of resources and the prevention of negative impacts on the natural environment must be made.

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.