



## Teaching Guide

Identifying Data				
Subject (*)			Code	2019/20
Thermo-mechanical properties of materials. Fundamental Methods			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	Artiaga Diaz, Ramon Pedro		E-mail	ramon.artiaga@udc.es
Lecturers	Artiaga Diaz, Ramon Pedro López Beceiro, Jorge José		E-mail	ramon.artiaga@udc.es jorge.lopez.beceiro@udc.es
Web	<a href="http://eps.udc.es/diderot">http://eps.udc.es/diderot</a>			
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

Code	Study programme competences
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		
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	Ordinary class hours	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 presented 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	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.
Guest lecture / keynote speech	
Laboratory practice	No academic dispensation is accepted.
Objective test	

## Assessment

Methodologies	Competencies	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


## Sources of information

<b>Basic</b>	<p>O sistema de Biblioteca de la UDC permite realizar búsquedas de literatura recomendada por profesor e materia. Esta é unha listaxe ampliada de fontes recomendadas: Mechanical properties of polymers and composites / Lawrence E. Nielsen, Robert F. Landel Nielsen, Lawrence E. Esc Politécnica Superior -- CM P 154 Thermal analysis. Fundamentals and applications to material characterization: proceedings of the international seminar: Thermal analysis and rheology. Ferrol, Spain, 30 Juny-4 July, 2003 / Ramón Artiaga Díaz (ed.), A Coruña: Universidade da Coruña, Servicio de Publicacions, 2005, ISBN 84-9749-100-9 Thermal analysis of polymers / edited by Joseph D. Menczel, R. Bruce Prime; Hoboken, N.J.: John Wiley, [2009], ISBN 978-0-471-76917-0 Thermal characterization of polymeric materials / edited by Edith A. Turi, San Diego : Academic Press, 1997, 2nd. ed. ISBN 0-12-703781-0 (v.1) 0-12-703782-9 (v.2)</p>
<b>Complementary</b>	

## Recommendations

<b>Subjects that it is recommended to have taken before</b>
<b>Subjects that are recommended to be taken simultaneously</b>
Termomechanics of Materials Properties. Advanced Methods/730495004
<b>Subjects that continue the syllabus</b>
<b>Other comments</b>



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 support  
- It will be done through Moodle, in digital format without the need to print them.  
- If 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.