

Module: Residue management and valorisation						
Course: Recycling Systems & novel business models for the second life of residues						
Educational profile: general						
ECTS points 2						
Education level: 5 EQF						
Prerequisites	Secondary education Knowledge of the basics of natural sciences					
Target group	A course dedicated to people who want to gain and deepen their knowledge of the recycling systems and secondary life of polymer packaging in the context of the development of the circular economy					
CLASS LANGUAGE	ENGLISH					
LECTURER						
Number of hours of classes within individual forms of classes	Lectures	Classes	Workshops	Seminar	Project	Laboratories
	10	5	5			
COURSE OBJECTIVES	<p>C1. Acquiring knowledge in the optimization of recycling systems.</p> <p>C2. Acquiring knowledge of mechanical recycling of plastic packing waste.</p> <p>C3. Acquiring an understanding of novel business models for the second life of residues.</p> <p>C4. Acquiring knowledge about chemical routes for recycling</p>					
Reference to learning outcomes	Description of learning outcomes				Verification of learning outcomes	
Knowledge						
C1, C2	Theoretical basis of knowledge about mechanical recycling systems				Media follow-up	



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C1, C4	Theoretical basis of knowledge about chemical routes for recycling.	Media follow-up
C1, C3	Reuse of packaging and uses of residual waste, and uses of recyclable materials	Media follow-up
C1, C3	The industrial uses of the waste-based composite products	Media follow-up
C2, C3	Polymeric materials, machinery, and equipment	Media follow-up
C1, C3	Packaging economy aspects, business processes models, new recycling opportunities.	Media follow-up
Skills		
C1, C3	Student can find/create new business models with added value to recycled material	Role play
C2, C4	Student can inspect recycling procedures	Role play
C1, C3	Student can identify new recycling opportunities	Role play
C3	Student will be able to develop communication skills within production value chain	Role play
C3	Student will acquire the ability of developing transversal skills in the packaging sector for consideration of recyclability or reuse during the whole product life cycle	Role play
C3	Student can redesign of products in terms of new material properties, and creativity.	Role play
Responsibility and autonomy		
C1, C3	Responsibility on team working to redesign processes.	Individual portfolio
C1, C3	Responsibility on data collection and data analysis for decision making in collaboration with different departments	Individual portfolio
C1, C3	Autonomy to find new market niches for recyclable materials.	Individual portfolio



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Students' own workload (in didactic hours 1h did.=45 minutes)**		
Participation in lectures	10	
Participation in classes	10	
Participation in workshops	5	
Preparation to classes	5	
Preparation to lectures	5	
Preparation to an examination	5	
Project tasks	5	
Credit/examination	5	
others (indicate which)		
TOTAL:	50	
ECTS points:	2	
PREREQUISITES	Lectures	Seminars
COURSE CONTENT	<p>1. Optimization of plastics recycling</p> <ul style="list-style-type: none"> - Reduction of sorting processes - Upcycling of plastic waste by blending - Increasing the recycling rate. <p>2. Mechanical recycling of packaging waste.</p> <ul style="list-style-type: none"> - Structure of recycling chains for packaging wastes - Technologies of the pre-enrichment level. - Refinement <p>3. Chemical routes for recycling. Dissolving, catalytic, and thermochemical technologies.</p> <ul style="list-style-type: none"> - Depolymerization and leaching. - Thermochemical recycling of plastics waste. 	<p>1. Secondary plastic products. Examples and market trends.</p> <p>2. Future prospects of chemical recycling</p>



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LITERATURE (compulsory reading)	<p>Introduction to Plastics Recycling. Vannessa Goodship. Smithers Rapra Technology Limited. 2007</p> <p>Understanding Plastics Recycling. Natalie Rudolph, Raphael Kiesel, Chuanchom Aumnate. Hanser Publications.</p> <p>Polymers : The Environment and Sustainable Development. Adisa Azapagic. Wiley.</p>
OPTIONAL LITERATURE (including at least two items in English, either books or articles)	
SCHOLARLY PUBLICATIONS BY PERSONS WHO CONDUCT CLASSES, WHICH ARE RELATED TO THE MODULE SUBJECT	<p><u>Campus Iberus</u></p> <p>Cristina Nerín is Full Professor of Analytical Chemistry at the University of Zaragoza (Spain). Member of WG Recycling in EFSA from 2010 to 2018 and Director of Master in Environmental Engineering at the University of Zaragoza from 1990 to 2012. Research topics: Food contact materials, virgin and recycled, migration, NIAS and development of new materials.</p> <p>Robert Soliva-Fortuny is full professor in the area of Food Technology at University of Lleida. His research is driven by the development of high-quality, safe and healthy products by combining novel and conventional processing and packaging techniques. He has been working on edible and biodegradable films and their application to MAP systems.</p> <p>Alberto Navajas is Assistant Professor at the Public University of Navarre (Spain) and member of the research unit Chemical Reactors and Processes for the Valorization of Renewable Resources. Research topics: Photocatalyst, and Ecodesign by life cycle assessment. Teaching experience: Chemistry, Polymeric Materials, and Ecodesign.</p>



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	<p>Elena Canellas is Senior Doctor at the University of Zaragoza, Spain. Degree in Biochemistry, Master in Environmental Engineering and PhD- Doctor in Analytical Chemistry at the University of Zaragoza. She obtained an Inncorpora-Torres Quevedo official grant for doing the postdoc in the company Samtack SL (Barcelona). Research topics: migration study of toxic or carcinogenic non intentionally added substances (NIAS) from food packaging to food focusing on all types of packaging including bioplastics and recyclable plastics, development of active packaging to prevent food spoilage.</p> <p><u>Ecoembes</u></p> <p>Daniel Menchaca is Telecom Engineer (Universidad de Zaragoza) with a master degree in Project Management with more than 19 years of experience leading with digital, smart cities and sustainability projects. Now, working in the field of smart waste management with a strong committed to the environment and the Circular Economy as part of Ecoembes' The Circular Lab.</p> <p>David Ceniceros is a BA graduate, master on Teaching in Economics. Specialized on Circular Economy and Design Methodologies for innovation, currently embarked on an entrepreneurial project called Sustained focused on developing open innovation strategies with companies for boosting their transition to a circular model.</p>
<p>TEACHING METHODS</p>	<p>Lecture Team work Practical tasks Case study Working with text Error identification Peer Review</p>
<p>TEACHING AIDS</p>	<p>Presentations Role play script Media Contents</p>



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FORM AND CONDITIONS OF ASSESSMENT	No exam, media follow up assessed by teacher, peer and teacher evaluation of participation role play, portfolio assessed by teacher, self-assessment as a part of portfolio All these have to be completed to pass the course.
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