PACKALL
PackAlliance:
European alliance for innovation training
& collaboration towards future packaging

Module: Eco-design and novel manufacturing processing						
Course 1: Novel Manufacturing Processing for Packaging Systems						
Educational profile: general						
ECTS points 3						
Education level: 5 EQF						
Prerequisites	Secondary education Knowledge of the basics of natural sciences					
Target group	A course dedicated to students who have an interest in packaging technologies and and want to gain an applied knowledge of industrial problems of processing and packaging industries, especially for applications in the food sector, and to professionals in the packaging industry who want to get a higher level of skills, adapting it to recent technological developments, innovation and sustainability in the packaging sector.					
CLASS LANGUAGE	ENGLISH					
LECTURERS	Loredana Incarnato, Luciano Di Maio, Paola Scarfato, Emilia Garofalo, Annalisa Apicella, Arianna Pietrosanto, Valentina Di Pasquale, Tiziano Lessio					
Number of hours of classes within individual forms of classes	Lectures	Classes	Workshops	Seminar	Project	Laboratories
	15	6		3		6
COURSE OBJECTIVES	C1. Acquiring knowledge on innovative strategies to increase the food packaging systems sustainability by new materials, new processing techniques and/or surface treatments. C2. Acquiring knowledge on renewable and bio-based materials manufacturing techniques, on the main issues related to their processability, and the strategies for their properties' improvements. C3. Acquiring the ability to implement novel manufacturing approaches to develop sustainable packaging systems with recycled, renewable and bio-based materials. C4. Acquiring awareness on how new processing approaches can be applied to create sustainable packaging systems. C5. Acquiring knowledge on best practices through case studies with industry frontrunners.						

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Reference to learning outcomes	Description of learning outcomes	Verification of learning outcomes
Knowledge		
C1	Theoretical basis of knowledge about conventional and novel polymer processing technologies.	Test
C2	Theoretical basis of knowledge about manufacturing techniques of renewable and bio-based polymer materials.	Test
C1, C2, C3	Breakdown of novel manufacturing processes to develop sustainable packaging systems with recycled, renewable and bio-based polymer materials.	Test
C4, C5	Technical, sustainability and economy aspects and opportunities of new manufacturing processes.	Test
Skills		
C1, C2, C3	Use knowledge of novel manufacturing processes to develop sustainable packaging systems based on recycled, renewable and bio-based polymer materials.	Practical task
C1, C2, C3	Ability to identify the most appropriate manufacturing technology and conditions for processing of recycled, renewable and bio-based polymer materials.	Practical task
C1, C2, C3, C4, C5	Ability to select the most appropriate new manufacturing processes and materials to realize sustainable packaging solutions for targeted applications.	Practical task
Responsibility and autonomy		
C1, C2, C3	Critical assessment of the knowledge acquired in the field of conventional and new manufacturing processes in the context of their use in the food packaging production.	Practical task
C1, C2, C3, C4, C5	Autonomy in the choice of the most sustainable material and processing technology for the production of a specific packaging for a targeted application.	Practical task
C1, C2, C3, C4, C5	Ability to networking with different participants in the value chain.	Practical task
C1, C2, C3, C4, C5	Ability to apply the knowledge to simple real examples.	Practical task

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workload (in didactic hours 1h did. = 45 minutes)**	**Students' own**
Participation in lectures	15
Participation in classes	6
Participation in seminars	3
Participation in laboratories	6
Preparation to classes	5
Preparation to lectures	10
Preparation to an examination	15
Project tasks	10
Credit/examination	5
others (indicate which)	0
TOTAL:	**75**
ECTS points:	**3**

PREREQUISITES	Lectures	Seminars
COURSE CONTENT	Technologies for innovative sustainable polymer compounds (nanocomposites, active systems, recycled systems, biopolymers). Production processes for rigid plastic packaging: injection molding, blow molding, foaming. Production processes for flexible plastic packaging: cast film extrusion, film blowing. Manufacturing processes for new packaging solutions: cast and blown film coextrusion, lamination and coating. Innovation and sustainability in surface treatments.	Sustainable processing aids for the production of food contact packaging. Sustainable printing technologies. Novel processing technologies and Industry 4.0

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	Additive Manufacturing techniques (3D Printing) for rapid prototyping.	
LITERATURE (compulsory reading)	Materials provided in Moodle, and Todd Bukowski and Michael Richmond, *A Holistic View of the Role of Flexible Packaging in a Sustainable World,* report prepared for The Flexible Packaging Association, 2018 U. Altaf, V. Kanojia, A Rouf, *Novel packaging technology for food industry*, Journal of Pharmacognosy and Phytochemistry 2018; 7(1): 1618-1625. Lecture notes.	
OPTIONAL LITERATURE (including at least two items in English, either books or articles)	Arabinda Ghosh Technology of Polymer Packaging Hanser (2015) ISBN 978-1-56990-576-0 https://doi.org/10.3139/9781569905777 Gordon L. Robertson. Food packaging. Principles and practice. Publisher: Marcel Dekker (1993). CEFLEX | A circular economy for flexible packaging Available online: https://ceflex.eu/ (accessed on Nov 14, 2020). Grant Andy; Lugal Leyla; Cordle Mark, *Flexible Films Market in Europe: State of Play* - Eunomia. 2020 Nonclercq, A. *Mapping flexible packaging in a Circular Economy [F.I.A.C.E]*, 2016. K. Muita, M. Westerlund, R. Rajala, *The Evolution of Rapid Production: How to Adopt Novel Manufacturing Technology*, IFAC-PapersOnLine, vol. 48, Issue 3, 2015, 32-37. https://doi.org/10.1016/j.ifacol.2015.06.054. A. Riley, 14 - Plastics manufacturing processes for packaging materials, Editor(s): Anne Emblem, Henry Emblem,Packaging Technology,	

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	Woodhead Publishing (2012) Pages 310-360, ISBN 9781845696658, https://doi.org/10.1533/9780857095701.2.310 Amparo López-Rubio, Eva Almenar, Pilar Hernandez-Muñoz, Jose M. Lagarón, Ramón Catalá & Rafael Gavara, *Overview of Active Polymer-Based Packaging Technologies for Food Applications*, Food Reviews International 2004; 20:4, 357-387, DOI: 10.1081/FRI-200033462
SHORT BIO OF PERSONS WHO CONDUCT CLASSES, WHICH ARE RELATED TO THE MODULE SUBJECT	**Loredana Incarnato** is Full Professor of Material Science and Technologies at the Department of Industrial Engineering of Salerno University, teaching courses in Polymer Technology, Food Packaging and Innovative Materials and Technologies for Sustainable Packaging. Her expertise in composition-process-structure-property relationships of polymer systems leads her into development of innovative and sustainable packaging solutions based on biopolymers, recycled polymers, active technologies and nanotechnologies. She is the author of over 130 papers in peer-reviewed journals and conference proceedings. **Luciano Di Maio** is Full Professor of Material Science and Technologies at the Department of Industrial Engineering of Salerno University, teaching courses in Material Technology, Food Packaging and Advanced Technologies for Food Packaging. His expertise in polymer processing technologies leads him into investigations in the fields of processability, recyclability and performance improvement of conventional and innovative polymer systems. He is the author of over 110 papers in peer-reviewed journals and conference proceedings. **Paola Scarfato** is Associate Professor of Material Science and Technologies at the Department of Industrial Engineering of Salerno University, teaching courses in Material Technology, Applied Chemistry Technologies and Polymer Nanocomposites. Her research interests are focused on sustainability and recyclability of polymer packaging and on development of multifunctional polymer systems through modification, blending and additivation strategies. She is the author of about 100 papers in peer-reviewed journals and conference proceedings. **Emilia Garofalo** is a specialized technician at the Department of Industrial Engineering of the University of Salerno. Her research activity is focused on the study of the processing-structure-property relationships in several polymer systems

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	(nanocomposites, recycled, biodegradable and active food-packaging), and on the valorization of mixed plastic wastes. She is the author of over 30 papers in peer-reviewed journals and conference proceedings. **Annalisa Apicella** is a Postdoctoral Research Fellow within the research group of Materials Science and Technology at the Department of Industrial Engineering of University of Salerno. Her research interests are focused on investigating innovative routes for the development of sustainable, multi-functional polymeric films for food packaging applications. She is a specialist on the design, realization and modelling of new packaging solutions with high active/passive barrier properties and increased thermal resistance. **Arianna Pietrosanto** is a Postdoctoral Research Fellow at the Department of Engineering of University of Sannio. She obtained her PhD in Industrial engineering at Salerno University in the 2021. Her research interests focus on the development of sustainable food packaging solutions made by biodegradable or biobased polymeric blends and on the safety aspects of polymeric food packaging. **Valentina Di Pasquale** is Assistant Professor in Industrial Systems Engineering at the Department of Industrial Engineering of Salerno University, teaching courses of Operations Management in Smart Manufacturing Systems. Her research interests are focused on Human Factors in Manufacturing and Services, Human Reliability Analysis, Scheduling and Optimization, Sustainable Production, Logistics in production and services. **Tiziano Lessio,** graduated in electronics and telecommunications in 1998. He has been working in plastics production companies in the automotive, vending, electro technical, medical sectors, dealing with the industrialization of new molds. Currently he is involved in injection molding with new technologies such as mucell, heat & cool. For several years, he has been training in the injection molding process.
TEACHING METHODS	Lectures Team work Practical tasks Case studies

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	Peer review
TEACHING AIDS	Classes by supervising teachers Presentations Media Contents Additional teaching materials
FORM AND CONDITIONS OF ASSESSMENT	Practical online tasks Project work in teams Test

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