UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2018/2019
MASTER'S DEGREE (MSC)	ENGINEERING AND INNOVATIVE TECHNOLOGIES FOR THE ENVIRONMENT
SUBJECT	PRINCIPLES OF CIRCULAR ECONOMICS
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	20937-Attività formative affini o integrative
CODE	19115
SCIENTIFIC SECTOR(S)	ING-IND/11
HEAD PROFESSOR(S)	LONGO SONIA Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	ENERGY SYSTEMS LCA - Corso: ENERGETIC AND NUCLEAR ENGINEERING ENERGY SYSTEMS LCA - Corso: INGEGNERIA ENERGETICA E NUCLEARE
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**LONGO SONIA** Thursday 10:00 12:00 Dipartimento di Ingegneria, Viale delle Scienze Ed.9, 1° piano, stanza S09P1021

DOCENTE: Prof.ssa SONIA LONGO

PREREQUISITES	Good knowledge of of mathematics
LEARNING OUTCOMES	Knowledge and understanding skills: The student will gain knowledge and understanding on the main solutions for the improvement of the environmental performance of products, services and organizations, the European directives on the energy and environmental performance of products and systems as well as the standards on Life Cycle Assessment (LCA). Furthermore, the student will gain knowledge and understanding on the application of the LCA methodology to products and services, with particular attention to the mass and energy balances, and the energy and environmental impacts of the examined products and services. Applications of the understanding and knowledge gained: The student will be able to identify the main solutions for the improvement of the environmental performance of products, services and organizations, to perform complete LCAs of products and services, to calculate their carbon footprint and product environmental footprint, and to define eco-design solutions for reducing their energy and environmental impacts. Autonomy in critical judgment: The course will allow the student to comprehend the main problems to face when assessing the energy and environmental performance of products, services and organizations, to suggest eco-design solutions and to assess their effectiveness. Furthermore, the student will be able to understand the basics of circular economy and industrial ecology, to understand and critically analyze the LCA results. Communication skills: The lectures and the final examination features aim at the development of the students' communication skills towards all the private and institutional stakeholders. Learning objectives: The student will gain knowledge in the technical-engineering field and will be able to apply the skills acquired during the classes. Furthermore, the student will gain terminologies, languages, mathematical and descriptive methods that characterize the industrial ecology, the LCA methodology, the circular economy.
ASSESSMENT METHODS	The exam is based on a single oral test, aimed to verify the level of knowledge and competencies expected for the course; the final grade ranges from 0 to 30. The maximum grade is given if the exam clarifies that the students master the following three skills: critical and interdisciplinary judgement in the topics of the course; well-developed skills in the understanding of the impacts of the topics of the course in the sector we are considering, a well-developed ability to represent ideas and/or innovative solutions in the context of the discipline. The student will develop solutions of exercises and he will also discuss the topics studied during the course. The questions asked to the students, either open or semi-structured and tailored to test the learning results expected will verify: a) learning verification, b) elaboration capabilities, c) verbal capabilities. The minimum number or oral questions during the exam is 3. a)The learning verification by the student will be performed through the analysis of the capability of the student to perform connections between the theoretical and practical contents of the course, b)About the elaboration capabilities of the students, the following skills will be evaluated: b1) perform personal evaluations about the contents of the course; b2) understanding the applications or the implications of the contents in the context of the topics of the course; b3) allocate the contents of the course in the professional and technological reference context; b4) capability of reading and understanding complex systems. c)In the field of the verbal skills, the student will receive the lowest grade if he/ she shows a language skill adequate to the professional context but still not optimal, while the maximum grade will be assigned to the students having a complete understanding and mastery of the technical language skills required. Grades rating Excellent 30 - 30 cum laude: excellent knowledge of the topics, excellent language skills, the student is able to apply knowledge to solve problems. Very good 26-29: good knowledge of the topics of the course, full mastery of language, the student is able to apply knowledge to solve the proposed problems. Good 24-25: basic knowledge of the main topics, basic technical language skills, limited ability to independently apply knowledge to the solution of problems. Satisfactory 21-23: the student does not have full capabilities but has the knowledge, satisfactory technical language skills, poor ability to independently apply knowledge to problems and different domains. Sufficient 18-20: the student has minimal knowledge of the course topics and minimal technical language, very little or no ability to independently apply the knowledge.

	Insufficient: the student does not have an acceptable knowledge of the course topics.
EDUCATIONAL OBJECTIVES	The course aims at giving the necessary knowledge to find solutions to improve the environmental performance of products, services and organizations, to apply the Life Cycle Assessment methodology to products and services, to calculate their carbon and product environmental footprint, and to define eco-design solutions
TEACHING METHODS	Lectures and coursework (including examples, exercises and modeling creation).
SUGGESTED BIBLIOGRAPHY	1) Standard UNI EN 14040, 14044 2) Materiali didattico fornito durante le lezioni

SYLLABUS

Hrs	Frontal teaching
1	Introduction to the course
5	Circular economy
1	Introduction to the Life Cycle Assessment (LCA). Methodological principles and basic features of LCA. The steps of LCA
1	The standards for LCA. The international standards of ISO 14040 series
4	The first step of LCA: the goal and scope definition. Functional unit, system boundaries, impact categories. Allocation and cut-off rules. The report of a LCA study
3	Data collection and data quality in LCA. Software and databases for LCA
4	Life Cycle Inventory (LCI): analysis of process-based and matrix methods
3	Environmental indicators and indices. Life Cycle Impact Assessment (LCIA): indicators and impact assessment methods. Carbon footprint and product environmental footprint calculation
3	Interpretation step: analysis of the results and dominance analysis. Uncertainty and sensitivity analysis. Definition of eco-design criteria
2	Case studies on LCA applied to products and services
2	Industrial ecology and industrial symbiosis

Hrs	Practice
25	Exercises on the different stepd of the LCA. Application of the LCA methodology to a product.