UNIVERSITÀ DEGLI STUDI DI PALERMO

DIPARTIMENTO	Ingegneria		
ANNO ACCADEMICO OFFERTA	2015/2016		
ANNO ACCADEMICO EROGAZIONE	2015/2016		
CORSO DILAUREA MAGISTRALE	INGEGNERIA ENERGETICA E NUCLEARE		
INSEGNAMENTO	BUILDING PHYSICS AND LCA OF ENERGY SYSTEMS C.I.		
CODICE INSEGNAMENTO	18042		
MODULI	Si		
NUMERO DI MODULI	2		
SETTORI SCIENTIFICO-DISCIPLINARI	ING-IND/11		
DOCENTE RESPONSABILE	CELLURA MAURIZIO	Professore Ordinario	Univ. di PALERMO
ALTRI DOCENTI	LONGO SONIA CELLURA MAURIZIO	Professore Associato Professore Ordinario	Univ. di PALERMO Univ. di PALERMO
CFU	12		
PROPEDEUTICITA'			
MUTUAZIONI			
ANNO DI CORSO	1		
PERIODO DELLE LEZIONI	1° semestre		
MODALITA' DI FREQUENZA	Facoltativa		
TIPO DI VALUTAZIONE	Voto in trentesimi		
ORARIO DI RICEVIMENTO DEGLI STUDENTI	**CELLURA MAURIZIO** Mercoledì 10:00 13:00 Stanza Prof. Cellura **LONGO SONIA** Giovedì 10:00 12:00 Dipartimento di Ingegneria, Viale delle Scienze Ed.9, 1° piano, stanza S09P1021		

DOCENTE: Prof. MAURIZIO CELLURA

PREREQUISITI	
RISULTATI DI APPRENDIMENTO ATTESI	Building Physics Knowledge and understanding skills The student will gain knowledge and understand to work with energy efficiency principles in buildings in particular in the field of building envelope energy performance. The main European directives aiming at the determination of energy performance of buildings as well as energy efficiency and savings in the building sectors will be described during the course. Applications of the understanding and knowledge gained The student will be able to perform a complete energy analysis of a building, selecting the optimal design solutions, the most appropriate materials for the envelope aiming towards sustainability and energy efficiency in buildings. The student will gain an understanding of the 'state of the art' thermal loads calculation methodologies and will have experience of the most relevant thermal-physical simulation software and their theoretical fundamentals. Autonomy in critical judgement Students will understand the basics of building simulation, will gain an understanding of robust simulation techniques and of the relation of the main building simulation parameters. Students will be able to understand and critically analyze building simulation results. The aforementioned outputs of the course will allow the student to comprehend the main problems to face when assessing building energy performances, identify the optimal design solutions and suggest the optimal retrofit options for existing buildings. 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 Gain knowledge in the technical-engineering field, be able to apply the skills acquired during previous classes. LCA of energy systems Knowledge and understanding skills The student will gain knowledge and understanding on the main European directives on the energy and environmental performances 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 energy technologies and energy systems, in particular regarding mass and energy balances, and energy and environmental impacts of the examined technologies and systems. Applications of the understanding and knowledge gained The student will be able to perform complete LCAs of energy technologies and energy systems, to calculate their carbon footprint and product environmental footprint, and to define eco-design solutions for reducing their energy and environmental impacts. The student will gain an understanding of the LCA calculation methodologies and will have experience of the most relevant LCA software and databases, and their theoretical fundamentals. Autonomy in critical judgment The outputs of the course will allow the student to comprehend the main problems to face when assessing energy and environmental performances of energy technologies and energy systems, to suggest eco-design solutions and to assess their effectiveness. Furthermore, students will be able to understand and critically analyze 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 previous classes. Furthermore, the student will gain terminologies, languages, mathematical and descriptive methods that characterize the LCA, the carbon footprint and the product environmental footprint.
VALUTAZIONE DELL'APPRENDIMENTO	Oral examination, presentation of a thermal building simulation and of a life cycle assessment study developed during the course
ORGANIZZAZIONE DELLA DIDATTICA	Lectures (including integrated examples and modeling sessions), coursework

MODULO
BUILDING PHYSICS

Prof. MAURIZIO CELLURA

TESTI CONSIGLIATI

- Load calculation applications Manual SI edition – Jeffrey D. Spitler ASHRAE, 2014.
- ASHRAE Handbook of fundamentals, 2013
- II Guida AICARR – Introduzione alla simulazione termo-energetica dinamica degli edifici Edizione 2012, ISBN 978-88-97323-14-3
- Lecture notes

TIPO DI ATTIVITA'	B
AMBITO	50367-Ingegneria energetica e nucleare
NUMERO DI ORE RISERVATE ALLO STUDIO PERSONALE	96
NUMERO DI ORE RISERVATE ALLE ATTIVITA' DIDATTICHE ASSISTITE	54

OBIETTIVI FORMATIVI DEL MODULO

The course aims to give students the necessary knowledge in the topics of energy efficient building design, in compliance with the regulations in force and the energy and environmental requirements of the building sector.

PROGRAMMA

ORE	Lezioni
1	Introduction
2	Fundamentals of building heat transfer
4	Bioclimatic building design
6	Features of the indoor environment: air infiltration, ventilation and internal gains
8	Thermal-physical performance of the building: calculation methods
3	Net zero enery buildings

ORE	Esercitazioni
30	Thermal-physical performance of a building • Thermal loads calculations according the ASHRAE Methods • Application of the Radiant Time Series Method, Modeling of a case study, through a non-steady state building modeling tool • Building modeling through a bioclimatic approach, • Calculation of the thermal loads, • Critical analysis of the results towards robust modeling, • Optimization of the design and parametric analysis.

MODULO
LCA OF ENERGY SYSTEMS

Prof.ssa SONIA LONGO

TESTI CONSIGLIATI

1) Standard UNI EN 14040 e UNI EN 14044
2) ILCD Handbook – International Reference Life Cycle Data System, available on http://eplca.jrc.ec.europa.eu/
3) Guidance for the implementation of the EU Product Environmental Footprint (PEF), available on http://ec.europa.eu/environment/eussd/smgp/productfootprint.htm
4) Lecture notes

TIPO DI ATTIVITA'	B
AMBITO	50367-Ingegneria energetica e nucleare
NUMERO DI ORE RISERVATE ALLO STUDIO PERSONALE	96
NUMERO DI ORE RISERVATE ALLE ATTIVITA' DIDATTICHE ASSISTITE	54

OBIETTIVI FORMATIVI DEL MODULO

The course aims at giving the necessary knowledge for the application of Life Cycle Assessment methodology to energy systems, for the calculation of their carbon and product environmental footprint, and for the definition of eco-design solutions.

PROGRAMMA

ORE	Lezioni
1	Introduction
2	Analysis of European directives on energy and environmental performances of products and energy services
1	Introduction to the Life Cycle Assessment (LCA). Methodological principles and basic features of LCA. The steps of LCA
2	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
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
2	Life Cycle Impact Assessment (LCIA): indicators and impact assessment methods. Carbon footprint and product environmental footprint calculation
2	Interpretation step: analysis of the results and dominance analysis. Uncertainty and sensitivity analysis. Definition of eco-design criteria
1	Format for reports of LCA studies
2	Case studies on LCA applied to energy technologies and energy systems

ORE	Esercitazioni
30	Application of the LCA methodology to an energy technology of an energy system. Use of software and databases for LCA