UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2023/2024
MASTER'S DEGREE (MSC)	ELECTRONICS ENGINEERING
SUBJECT	PHOTOVOLTAIC DEVICES AND TECHNOLOGIES
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	20925-Attività formative affini o integrative
CODE	19641
SCIENTIFIC SECTOR(S)	ING-INF/01
HEAD PROFESSOR(S)	CRUPI ISODIANA Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**CRUPI ISODIANA** Tuesday 17:00 19:00 Viale delle Scienze, Building 9, 2nd floor, room U218

DOCENTE: Prof.ssa ISODIANA CRUPI

PREREQUISITES	For the successful achievement of the objectives, the student should have good knowledge of Mathematics, Physics and Electronics.
LEARNING OUTCOMES	- Knowledge and comprehension capacity At the end of the course, the student will have acquired knowledge and comprehension capacity on: the fundamental characteristics and the working principle of the most widely used solar cells; various technologies and innovations for the future of photovoltaics, the operating principle of laboratory instrumentation and related experimental techniques for the characterization of photovoltaic devices; design, analysis and characterization of solar cells and systems; the physical principles and the mathematical physics useful to understand the energy conversion; the multidisciplinary scientific context covering Engineering. - Ability to apply the acquired knowledge At the end of the course, the student will be able to: identify, formulate and analyze the fundamental set of problems related to the use of photovoltaic devices and systems, by means of up-to-date methods, techniques and tools; understand photovoltaic phenomena, circuits and systems; be acquainted with the physical parameters and the terminology related to the field; understand how to use electronic circuits in the field of solar photovoltaic energy. - Ability to evaluate scenarios The student will have gained the autonomy required to correctly employ the circuits presented in the course. - Communication skills The student will be able to: communicate and express problems related to photovoltaics; be acquainted with the physical parameters and the terminology of the fields; talk about the up-to-date subject matters applicable to energy conversion; to competently talk also with the general public. - Learning ability The student will be able to: deal with the study of photovoltaic systems; recognize the need for an independent learning during all the lifetime; independently carry out bibliographical researches; independently read and understand a specialized text; attend seminars and workshops and understand the oral speeches and the proceedings.
ASSESSMENT METHODS	Oral exam supported by a Power Point project The learning evaluation will be carried out by means of written tests all along the course duration and a final oral examination supported by a Power Point presentation. The project, with topic chosen by the student, can be developed by the single student or within a small team (max four) to support the cooperative learning. The final oral examination consists of a series of questions, which are meant to assess whether the student has acquired the skills and subject knowledge expected from the course. For each question, the student will first have to contextualize the subject within the course, describe its meaning and importance, for example by means of formal definitions and scope of applications, and define the study methods and eventually the validity limits. Finally, the student will have to discuss the topic by a correct use of language and a fluent analytical treatment. At the end of the exam, the examination committee informs the student whether he/she has passed the exam. If the examination has been passed, the committee gives the final result to the student based on the following evaluation criteria: EXCELLENT (30 - 30 cum laude): the student demonstrates an excellent knowledge of the topics and mastery of the course contents, excellent mastery of language and high analytical capability; the student is able to apply his knowledge to solve the proposed problems. Laude is given to students who have demonstrated a particular brilliance in the exposition and in the written test. VERY GOOD (28 – 29): the student demonstrates a very good knowledge of the subjects, a full mastery of language, analytical-synthetic ability and is able to apply knowledge to solve the proposed problems. GOOD (26-27): the student demonstrates good knowledge of the main topics and good analytical skills. The student is able to apply the knowledge to solve the proposed problems, but with some uncertainty. Communication skills may not be optimal. QUITE GOOD (24-25): the student demonstrates a fair knowledge of the main topics, a discrete command of language and a limited ability to independently apply the knowledge to the solution of the proposed problems SATISFACTORY (21 – 23): the student does not have full capabilities but has the knowledge, a satisfactory command of language and a poor ability to independently apply the knowledge SUFFICIENT (18 – 20): the student has minimal knowledge of 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 topics and/or did not deliberately studied some topics of the subject.
EDUCATIONAL OBJECTIVES	Introduce the different aspects of photovoltaic technology, from the properties of sunlight and the physics of solar cells and continuing with a circuital approach to

	describe at the system level the behavior of a photovoltaic field. The objective is to provide the specific knowledge for the design, analysis and characterization of solar cells.
TEACHING METHODS	Frontal lectures and tutorials, lab experiments. The course will be held in English.
SUGGESTED BIBLIOGRAPHY	Materiale didattico di riferimento sugli argomenti svolti nel corso delle lezioni e sulle applicazioni sviluppate nelle esercitazioni verrà reso disponibile dal docente sul sito del corso. I testi ausiliari sono: “Solar Energy: The Physics and Engineering of Photovoltaic conversion, Technologies and Systems”, Arno Smets, Klaus Jäger, Olindo Isabella, Renè van Swaaij, Miro Zeman, Publisher: UIT Cambridge Ltd ISBN: 978-1906860325 (gratis in EBOOK); accessible at UNIPA Discovery Service. http://www.pveducation.org/ Massive Open Online Course (MOOC), on Solar Energy given by Arno Smets on the edX.org platform.

SYLLABUS

Hrs	Frontal teaching
4	Introduction to the course. Energy sources and environmental issues. Past and present of Photovoltaics.
4	Working principle of a solar cell. Properties of the sunlight.
4	Basic semiconductor physics, generation and recombination of e-h pairs, semiconductor junctions.
4	Solar cell parameters and equivalent circuit.
4	Efficiency limits. Losses mechanisms. Solar cells design rules.
10	Best research cell efficiencies. PV technologies: c-Si solar cells, thin film solar cells, 3rd generation photovoltaics.
6	PV systems: components and design

Hrs	Practice
8	Exercises on the analysis and design of the circuits presented in the course.

Hrs	Workshops
6	Laboratory experiments on solar cells.

Hrs	Others
4	Visit to local companies working in the PV field