



# UNIVERSITÀ DEGLI STUDI DI PALERMO

<b>DIPARTIMENTO</b>	Ingegneria
<b>ANNO ACCADEMICO OFFERTA</b>	2015/2016
<b>ANNO ACCADEMICO EROGAZIONE</b>	2015/2016
<b>CORSO DILAUREA MAGISTRALE</b>	INGEGNERIA ELETTRICA
<b>INSEGNAMENTO</b>	SISTEMI SOLARI
<b>TIPO DI ATTIVITA'</b>	C
<b>AMBITO</b>	20923-Attività formative affini o integrative
<b>CODICE INSEGNAMENTO</b>	18055
<b>SETTORI SCIENTIFICO-DISCIPLINARI</b>	ING-IND/11
<b>DOCENTE RESPONSABILE</b>	LO BRANO VALERIO      Professore Ordinario      Univ. di PALERMO
<b>ALTRI DOCENTI</b>	
<b>CFU</b>	6
<b>NUMERO DI ORE RISERVATE ALLO STUDIO PERSONALE</b>	96
<b>NUMERO DI ORE RISERVATE ALLA DIDATTICA ASSISTITA</b>	54
<b>PROPEDEUTICITA'</b>	
<b>MUTUAZIONI</b>	SOLAR ENERGY SYSTEMS - Corso: INGEGNERIA ENERGETICA E NUCLEARE SOLAR ENERGY SYSTEMS - Corso: ENERGETIC AND NUCLEAR ENGINEERING
<b>ANNO DI CORSO</b>	1
<b>PERIODO DELLE LEZIONI</b>	2° semestre
<b>MODALITA' DI FREQUENZA</b>	Facoltativa
<b>TIPO DI VALUTAZIONE</b>	Voto in trentesimi
<b>ORARIO DI RICEVIMENTO DEGLI STUDENTI</b>	<b>LO BRANO VALERIO</b> Giovedì    12:00    13:30    edificio 9

**DOCENTE:** Prof. VALERIO LO BRANO

<b>PREREQUISITI</b>	
<b>RISULTATI DI APPRENDIMENTO ATTESI</b>	The course aims to provide the basics and a methodology for the analysis of the main technologies of solar thermal and photovoltaic plants. At the end of the course students will be able to describe the various technologies, to size plants, to plan maintenance and to assess a pre-analysis of economic feasibility of the proposed solutions
<b>VALUTAZIONE DELL'APPRENDIMENTO</b>	Combination of oral and written exams
<b>OBIETTIVI FORMATIVI</b>	<p>Knowledge and understanding. The student will be able to know and to understand basics of solar energy conversion through the technologies presented in the course; will be able to estimate the energy availability of a site choosing the most appropriate technology to exploit it. Among the possible technical solutions, the student will make an analysis of economic feasibility.</p> <p>2. Applying knowledge and understanding. The student will produce technical reports relating to different topics with the application of technical knowledge, choosing among different solutions on the basis of economic optimization.</p> <p>3. Making judgements. The course provides students with basic technical knowledge but also the cultural elements to understand the policy implications of the social and environmental choices in the energy sector by providing a global overview useful for an independent understanding of the student. The student will find autonomously the information about the different types of solar systems, to detail proposed solutions and technologies and to make a consistent economic analysis. Moreover, often the student will propose assumptions to show the degree of maturity achieved in analyzing the issues proposed.</p> <p>4. Communication. This ability is stimulated during the drafting of the technical reports, during the design and the drafting of the plan, and during the analysis of technical and economic feasibility of renewable energy plants.</p> <p>5. Lifelong learning skills. The technical and cultural knowledge provided by the course allow the student who wants to continue their education or to begin his job in the company, to do so easily.</p>
<b>ORGANIZZAZIONE DELLA DIDATTICA</b>	Lessons
<b>TESTI CONSIGLIATI</b>	<p>Kalogirou, S. A. . Solar energy engineering: processes and systems. Academic Press.</p> <p>Sørensen, B. . Renewable Energy: Its physics, engineering, environmental impacts, economics &amp; planning. Academic Press, Incorporated.</p> <p>Duffie, J. A., &amp; Beckman, W. A. . Solar engineering of thermal processes (Vol. 3). New York etc.: Wiley.</p>

## PROGRAMMA

<b>ORE</b>	<b>Lezioni</b>
4	Introductory concepts. Energy sources and energy production. Correlation between Energy, Environment and Development. Classification of technologies of renewable sources. The legislation in the energy and environmental, Electricity Market. Sustainability of energy sources.
4	Heat transfer due to radiation, convection and conduction. The electromagnetic spectrum; body black and gray bodies. Heat transfer coefficients. Radiation characteristics of opaque materials.
5	Solar Power. Measures, experimental data and evaluations; measurement systems of direct and diffuse solar radiation. Simulation models of the solar radiation.
5	The energy balance of the Earth. Evaluation of the global radiation to the ground. Greenhouse effect.
12	Solar thermal collectors: general description, energy balance, temperature distributions, performance. Thermal storage. Simulation models of the solar thermal collector.
12	Photovoltaic systems: general description, energy balance, effect of temperature, performance. Photovoltaic effect - Photovoltaic cells - Materials - Features. Daily / annual incident solar energy - Installation of photovoltaic modules - Captured energy. Type of use: (isolated systems - systems connected to the network). Design and sizing of a photovoltaic system. Simulation models
<b>ORE</b>	<b>Esercitazioni</b>
1	Introductory concepts. Energy sources and energy production. Correlation between Energy, Environment and Development. Classification of technologies of renewable sources. The legislation in the energy and environmental, Electricity Market. Sustainability of energy sources.
2	Solar Power. Measures, experimental data and evaluations; measurement systems of direct and diffuse solar radiation. Simulation models of the solar radiation.
1	The energy balance of the Earth. Evaluation of the global radiation to the ground. Greenhouse effect.
1	Heat transfer due to radiation, convection and conduction. The electromagnetic spectrum; body black and gray bodies. Heat transfer coefficients. Radiation characteristics of opaque materials
3	Solar thermal collectors: general description, energy balance, temperature distributions, performance. Thermal storage. Simulation models of the solar thermal collector

ORE	Esercitazioni
4	Photovoltaic systems: general description, energy balance, effect of temperature, performance. Photovoltaic effect - Photovoltaic cells - Materials - Features. Daily / annual incident solar energy - Installation of photovoltaic modules - Captured energy. Type of use: (isolated systems - systems connected to the network). Design and sizing of a photovoltaic system. Simulation models,