UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2018/2019
BACHELOR'S DEGREE (BSC)	ENERGY ENGINEERING
SUBJECT	RENEWABLE SOURCES
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50299-Ingegneria energetica
CODE	16460
SCIENTIFIC SECTOR(S)	ING-IND/11
HEAD PROFESSOR(S)	BECCALI MARCO Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	153
COURSE ACTIVITY (Hrs)	72
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**BECCALI MARCO** Thursday 09:30 11:00 T 208, ed. 9

DOCENTE: Prof. MARCO BECCALI

PREREQUISITES	Knowledge of fundamentals of physics, thermodynamics, heat transfer, hydraulics, chemistry
LEARNING OUTCOMES	Knowledge and understanding Knowledge of physical and environmental phenomena, as well as technologies, for renewable energy exploitation (RES). Understanding problems, opportunities and limits; find design solutions in particular dealing with energy uses. Learning of fundamentals of physics and their application in energy conversion. Applying knowledge and understanding Learning of methods and tools able to fulfil design objectives related to proper use of resources throgh a correct match between final uses and conversion processes and technologies.. Knowledge of laws and standards about RES. Making judgements To be able to assess "energy and environmental qualities" of proposed syestems. To be able to understand how. Make own design choices not only considering standards guidelines and limitations. Communication skills Work in team with other professionals and stakeholders. Approach holistic design. Go ahead "greenpainting" of projects: be confident of analysis and calculations to support the quality of the project.
ASSESSMENT METHODS	There will be two written tests each one related to the subject items discussed in different periods. There will be at least 10 question per test. Questions need either closed and open answers. Each answer must be adequately commented. Teacher will assess: basic knowledge, mastery of language and the capacity to build relationships among theory and practical applications. Students that will fail one or both the written test can have access to oral examination. The assessment is carried out of thirty. Rating votes: excellent 30/30 e lode: excellent knowledge of the topics, excellent mastery of language, good analytic capability; the student is able to apply his knowledge to solve the proposed problems. Very good 26-29: good knowledge of the subjects, 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 command of language, limited ability to independently apply the knowledge to the solution of the proposed problems satisfactory 21-23: student does not have full capabilities but has the knowledge, satisfactory command of language, poor ability to independently apply the knowledge sufficient 18-20: student has minimal knowledge of topics and minimal technical language, very little or no ability to independently apply the knowledge insufficient: student does not have an acceptable knowledge of the topics
EDUCATIONAL OBJECTIVES	The course aims at providing the basic scientific principles behind all major renewable energy resources, such as solar, wind, geothermal, hydro and biomass. Staring form this point, lectures and exercises are focused on knowledges of main technologies for renewable energy harvesting and conversion. Student will have the capability to understand how to assess resource availability and potential, pros and cons of exploitation hypotheses. He will be able to make a pre design of several plant typologies, deals with economics and consider environmental advantages and drawbacks.
TEACHING METHODS	Lectures and exercises
SUGGESTED BIBLIOGRAPHY	Bent Sorensen, Renewable Energy, Academic Press, 4th Edition Materiale didattico fornito dal docente (Slides, reports and other written texts delivered by the teacher)

SYLLABUS

Hrs	Frontal teaching
6	Introduction, sustainability and climate change. General classification of Renewable Energy resources. Law in energy topics. Fundamentals of economics of energy.
12	Wind energy. Wind phenomena at macro, meso and microscale. Wind analysis, frequency (legge di Weibull) and vertical gradients. Maximum theorical power of a wind turbine (Betz). Blade design: lift and drag. Power factor of a turbine. Construction and operation of a wind turbine. Applications for remote sites, wind fields and off shore. Assessment of annual electricity production. Economics
10	Fundamentals of Solar Energy. Solar radiation. Basics of thermal and PV conversion, solar cooling and solar thermodynamics. Heat balance and efficiency of a solar thermal collector (Bliss law). Assessment of productivity.
10	Hydropower. Water energy potential, resource assessment. Fundamentals of hydraulcs. Basics and classification of hydropower plants. River and basin plants. Civil works and equipment. Water turbines: classification and properties. Economics. Assessment of annual production. Environmental impact.
10	Geothermal systems. Earth structure. Classification and assessment of geothermal resources. Electricity production. Direct uses of geothermal heat, heat pumps.

SYLLABUS

Hrs	Frontal teaching
12	Biomass. Classification, availability and use of different biomasses. Technologies for energy conversion. Production biofuels (biogas, pellet, biodiesel, ethanol, etc) and related technologies (anaerobic digestion, pyrolisis, gasification, chemical treatments, etc..). Power production and direct combustion. Economics and environmental impacts.

Hrs	Practice
8	Wind energy
4	Solar Energy