



COURSE: Applied Energy			
ACADEMIC YEAR: 2019/2020			
TYPE OF EDUCATIONAL ACTIVITY: Affine			
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phone: +390971205048		mobile (optional):	
Language: Italian			
ECTS: 9	n. of hours: 81 (48 lessons and 33 tutorials/practice)	Campus: Potenza Dept./School: Scuola di Ingegneria Program: Mechanical Engineering Master's Degree	Semester: I

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

The course offers advanced studies in scientific and technological topics in the field of renewable energy and nuclear engineering.

The course aims to provide advanced skills in solving energy problems, focusing on the analysis and the design of energy plants for energy processing and utilization in various fields of application. The program is designed to train the student to develop mathematical models and numerical simulations of complex energy systems, using renewable resources and nuclear energy. The student should be able to use these skills in modeling, design, optimization and verification, finalizing the understanding of the critical analysis and the resolution of typical energy engineering problems.

The autonomy of judgment and the communication skills are developed and strengthened through the development, with the active participation of the students during the laboratory lessons, of projects of thermal and electrical systems that make use of the integration of renewable sources. During the laboratory activities, students follow the development of projects on real cases and will communicate the results of the work partially done independently. Learning abilities are stimulated through the independent deepening of texts and specialist publications in the energy sector with particular regard to energy efficiency both on aspects of technical and legislative standards.

PRE-REQUIREMENTS

No.

SYLLABUS

The course offers advanced studies in scientific and technological topics applied in the field of renewable energy (PV, wind power, solar thermal energy, hydrogen energy) and nuclear engineering.

Specific aspects related to the characterization of the energy sources, to the energy conversion into thermal energy and electricity and to plant design criteria are studied in deep.

Italian energy balance (3 hours)

Analysis of electrical and thermal demand.

Solar radiation (8 hours)

Spectral characterization of solar energy; beam, diffuse, albedo and global irradiation.

Energy saving and optimization of final energy consumption (6 hours)

Calculation of heat losses: technical and legislative standards. Design, management and energy optimization of the building-plant system. Dynamic calculation method: UNI EN 52016. Energy Audit. Industry: energy saving practices on industrial processes.

PV energy (28 hours)

Structure of photovoltaic (PV) devices: energy bands in semiconductors; "p" and "n" types of doping; junction and electric field; photocurrent as electron - hole pairs; losses in the conversion. Operation principle and equivalent circuit of the solar cell. Current-voltage (I-V) and power-voltage (P-V) characteristics. Design of a grid connected PV



system: optimal sizing between PV modules and inverter. Assessment of PV energy production; economic analysis by Net-Present-Value method.

Solar thermal (12 hours)

The low temperature solar thermal energy. Hydronic losses and criteria for dimensioning a network. The solar thermal collector. Components of a solar thermal system: storage and control systems. Design of a solar thermal system. Photovoltaic and solar thermal hybrid systems. Fundamentals of solar cooling.

Wind power (14 hours)

Characterization of the wind: speed and direction; power density; surface roughness; statistic distributions.

Structure of a wind turbine: blades, hub, gearbox, electric generator, tower.

Operating Principle of a wind turbine: lift and drag in a blade; power coefficients.

Hydrogen energy (4 hours)

Electrolytic processes, fundamentals of fuel cells technology.

Nuclear Energy (6 hours)

General principles of nuclear fission reactors. Types of nuclear fission reactors. Basic notions of plasmas for controlled thermonuclear fusion.

TEACHING METHODS

Theoretical lessons: 48 hours; Classroom tutorials, Laboratory tutorials, Project works: 33 hours; seminars held by external experts: 4 hours.

EVALUATION METHODS

The aim of the exam is to test the level of achievement of the previously mentioned educational goals.

The exam is divided into 2 parts which are carried out on different dates.

- a written part (numerical solutions and one question on theoretical aspects) which consists of a part on the design of a PV plant and a numerical exercise on one of all the topics covered in the course. Moreover an open question about one of the topics of the program. The first part is passed acquiring at least the score 18/30. The time for the test is 2 hours and a half. It is not allowed to consult texts or use PCs and smart phones. It is allowed to use calculators;
- a mandatory oral test if the first test has been passed with a score less than 25/30. During the oral test the ability to link and compare different aspects covered during the course are evaluated; the test is passed with a score at least of 18/30.

The final score is obtained as the weighted average of the two scores with a weight of 0.7 for the first and 0.3 for the second part. If the first test is insufficient the student can not access to the second one and in any case both tests have to be sufficient. If one of the two tests is not sufficient, they must both be repeated.

TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

Lecture Notes.

Andrea Bartolazzi, "Le Energie Rinnovabili", Hoepli. - Rodolfo Pallabazzer, "Sistemi Eolici", Rubettino. - Francesco Groppi e Carlo Zuccaro, "Impianti Solari fotovoltaici a norme CEI", Editoriale Delfino. Orio De Paoli, "Sistemi solari fotovoltaici e termici", Celid. Mario A. Cucumo, "Ingegneria Solare, Principi ed applicazioni", Pitagora Editrice Bologna.

INTERACTION WITH STUDENTS

At the beginning of the course, after describing the objectives, program and methods of examination, the teacher provides students educational materials (by means of a dropbox shared folder). The list of students who intend to participate at the course will be completed.

Office hours: thursday 10:30 to 12:30 at the office n. 69, fifth floor – Scuola di Ingegneria, MACCHIA ROMANA, via dell'Ateneo Via Lucano, 10, Potenza, Italy.

In addition, the teacher is available for further office hours if previously contacted by e-mail.



Università degli Studi della Basilicata
Scuola di Ingegneria

EXAMINATION SESSIONS (FORECAST)¹

7/02/2020, 21/02/2020 03/04/2020, 22/05/2020, 30/06/2020, 17/07/2020, 25/09/2020, 23/10/2020,
04/12/2020

SEMINARS BY EXTERNAL EXPERTS YES NO

¹ Subject to possible changes: check the web site of the Teacher or the Department/School for updates.

