Università degli Studi della Basilicata
Scuola di Ingegneria

COURSE: Applied Energy			
ACADEMIC YEAR: 2016/2017			
TYPE OF EDUCATIONAL ACTIVITY: Affine			
TEACHER: Antonio D'Angola			
e-mail: antonio.dangola@unibas.it		website: http://oldwww.unibas.it/dangola/	
phone: +390971205048		mobile (optional): +393204371291	
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 applied in the field of renewable energy and nuclear engineering.

The course aims to provide advanced skills in energy problems, and the analysis of plant and systems 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.

PRE-REQUIREMENTS

Students must have acquired and assimilated the following knowledge provided by the courses of Physics and Circuits Theory:

- elementary concepts of work, heat, energy conservation equations, electromagnetism;
- numerical methods.

SYLLABUS

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Italian energy balance (4 hours)

Analysis of electrical and thermal consumptions updated to 2015.

Solar radiation (4 hours)

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

PV energy (30 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. Assessment of PV energy production; economic analysis by Net-Present-Value method. Design of a grid connected PV system: optimal sizing between PV modules and inverter.

Wind power (20 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; pitch and yaw regulations; pitch-adjustment toward stall/feather. Wind farms: interference among turbines. Environmental impact of wind turbines: acoustic noise.
Power size, diffusion of wind installations in the world.

Other renewable resources (16 hours)

Hydropower. Biomass. Solar, geothermal.

Nuclear Energy (6 huors)

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: 8 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 open question) 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, smart phones, calculators;
- a mandatory oral test if the first test has been passed with a score less than 26/30. 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 given by the weighted average of the two scores with a weight of 0.7 for the first and 0.3 for the second. If the first test is insufficient the student can not access the second one and in any case both tests have to be sufficient. If one of the two tests is insufficient 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 folders). The list of students who intend to partecipate at the course will be prepared.

Office hours: Tuesday 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.

EXAMINATION SESSIONS (FORECAST)[1]

6/02/2017, 23/02/2017, 07/04/2017, 26/05/2017, 30/06/2017, 21/07/2017, 22/09/2017, 27/10/2017, 4/12/2017

SEMINARS BY EXTERNAL EXPERTS YES ☒ NO ☐

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