UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Energetic Systems

2425-2-F7501Q074

Aims

The course aims to provide the student with the basic knowledge on systems of conversion, transport, distribution and final use of electricity, with particular attention to the methods and technologies used for the control and reduction of polluting emissions.

At the end of the course, the student will have the necessary knowledge to understand the performing characteristics and the functioning of the different types of electricity generation plants fueled with fossil, renewable and nuclear sources. He will also have acquired the knowledge of the advantages and disadvantages of the various energy conversion technologies, from a technical, economic and environmental point of view.

The course aims to give the student an adequate knowledge of the principles of thermodynamics, fluid dynamics, mechanics, electronics and electrotechnics to understand the process of electrical energy production plants.

The student will be able to understand and critically analyze energy and environmental issues, energy scenarios and policies implemented through laws, directives, resolutions and regulations at national and European level.

He will be able to understand the security issues of the electricity system deriving from high penetrations of non-programmable renewable resources, and the measures that will have to be implemented to guarantee the stability of the system, such as: smartgrid, energy storage systems and new electricity market rules.

During the course the following skills are learnt:

- understanding scientific articles related to energy conversion technologies and storage systems;

- communicating the topics studied both in oral and written form with appropriate technical language;

- understanding laws and directives issued in the energy field.

Contents

Aim of the course is to provide a basis for understanding and analyzing energetic, economic and environmental issues connected with the conversion of primary energy into electric energy, with its transport and distribution and with its final use. A hint is also given on up-to-date research in the field, to offer a long term view about the evolution of the electric system.

Detailed program

1. National energetic statistics:
- Evolution of supply and demand

2. Central production and distributed generation. Conversion from fossil fuels:
- steam turbines
- gas turbines and compressed air energy storage
- combined cycle
- gas microturbines
- clean coal technologies

- Diesel engine

- Otto engine

- Stirling engine
- fuel cells.

Cogeneration plants, heat pumps and energy efficiency.

Renewable sources: photovoltaic, wind, biomass, hydropower and pumped-storage power stations. Geothermal power plants. Waste to energy plants.

Nuclear plants: thermal and fast reactors, generation IV reactors.

3. Transmission, distribution and storage of electrical energy.

The evolution of the electrical system: distributed generation and demand-side management (smart grids).

4. The electric market: European directives, decrees and national laws, organization of the electricity sector, the market structure and the Power Exchange.

Balancing of the Power System, primary, secondary and tertiary reserve.

Prerequisites

General Physics

Teaching form

24 lessons two hours lectures, in person, Delivered Didactics

The course is in Italian.

Textbook and teaching resource

Availability of teaching materials (slides) provided by th teacher

Semester

first semester

Assessment method

The exam consists of an oral assessment in which the topics of the lessons are discussed, there are no ongoing tests.

The learning of the different technologies of electricity production, of energy storage systems and their different impact on the environment as illustrated in the course is evaluated. Furthermore, the student's abilities and attitudes are tested for the critical and comparative analysis of conversion technologies, illustrating advantages and limitations. Furthermore, the student’s speaking ability and language property are taken into consideration.

For the admission to the oral examination it is necessary to present a brief written report on a topic exposed in the course, this allows in particular to evaluate the student's synthesis ability, the report is then discussed in the exam.

In case of not passing the exam, there is no jump call and the preparation of a new written report is not required.

Office hours

The teacher is available to receive students by appointment via e-mail.

Sustainable Development Goals

AFFORDABLE AND CLEAN ENERGY