# Physics applied to Energetic Systems

Prof. Maria Chiesa

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The course aims to present the physical principles and the related technologies which drive the main processes of energy production and transformation, based both on fossil fuels and on renewable and nuclear sources.

At the end of the course, students will have acquired technical knowledge of the various energy production processes existing worldwide and skills in sizing energy plants based on technical, environmental and territorial parameters.

***COURSE CONTENT***

The main topics covered by the course are the following:

- Traditional energy systems for heat and electricity production: fundamentals of classical thermodynamics (first and second laws, entropy, enthalpy, Gibbs free energy and thermodynamic cycles); energy from fossil fuels (heat engines, internal combustion engines); electricity production, energy storage and transport;

- Renewable energy sources and their exploitation: hydroelectric, solar, thermal, photovoltaic, wind, wave, geothermal energy and biomass combustion appliances;

- Energy from hydrogen as an energy carrier: from hydrogen production to its storage and distribution over short, medium and long distances. The application of hydrogen for mobility and the stationary generation of electricity and heat. Low and high temperature fuel cells;

- Energy production from nuclear fission and fusion, reactions control, temporal evolution of fission reactors; fuel processing and cycle; risks factors and safety systems; management of nuclear waste.

***READING LIST***

E. Boeker- R. Van Grondelle, *Environmental Physics,* John Wiley & Sons, 1999.

Teacher’s ppt presentations.

***TEACHING METHOD***

The course is divided into frontal lectures through the presentation of slides and applicative exercises using a blackboard. A couple of guided visits to energy production plants located in the Province of Brescia are also foreseen.

***ASSESSMENT METHOD AND CRITERIA***

It is foreseen an oral exam. The exam will start discussing a topic chosen by the student among the ones covered by the course. Students’ knowledge on other topics will also be tested.

The presentation of the topic chosen by the student and the answers to the subsequent open-ended questions will together contribute to the final mark. A good presentation of the chosen topic will not result in passing the exam if students do not also demonstrate their acquisition of adequate knowledge and skills on the other course topics covered in the exam questions.

***NOTES AND PREREQUISITES***

Prerequisites of the course are a knowledge of Mathematical Analysis and General Physics (mechanics, thermodynamics, electromagnetism) acquired in the first two years of the three-year degree course in Mathematics.

Further information can be found on the lecturer's webpage at:

<https://docenti.unicatt.it/ppd2/it/docenti/15952/maria-chiesa/profilo>

*Office hours*

Prof. Maria Chiesa is available to meet students on appointment fixed by email: [maria.chiesa@unicatt.it](mailto:maria.chiesa@unicatt.it).