UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Energy Physics

2425-1-F1701Q094

Aims

Knowledge of the physical principles at the basis of primary energy resources, of their availability and possibility of use. Energy transformations. Combination of energy sources for sustainability

Contents

Definition of energy systems and related problems.
Fluid dynamics for energy conversion.
Introduction to nuclear energy.
Nuclear fission.
Nuclear Fusion.
Renewable energy sources: principles, sources and technologies
Fossil fuels: formation, reserves, combustion elements and calorific value.
Introduction to electricity distribution networks and storage systems.
Energy mix

Detailed program

Definition of the energy systems and related problems. Evolution of the energy request. Sustainability of energy systems. Capacity Factor, Energy Return On Investments.
Dynamics of fluids for energy conversion. Conservation of energy in an ideal fluid, Bernoulli equation, dynamics of a viscous fluid, lift and drag forces, circulation, flow on a wing profile, Euler equation for a turbine.
Elements of thermodynamics. Thermodynamic cycles for energy production and their efficiency.
Introduction to nuclear energy. Binding energy, stability curve, radioactive decay, drop model of the nucleus, hints

of the interaction of ionizing radiation with matter.
Nuclear Fission. Chain reaction, activation energy, neutronics, reactor kinetics and moderator. Operating diagrams of thermal neutron and fast neutron reactors. Fuel cycle
Nuclear fusion. Fusion reactions, hints of thermonuclear plasma physics, inertial confinement of plasma, plasma magnetic confinement, tokamak devices, thermonuclear reactor operation scheme.
Renewable sources of low-enthalpy thermal energy: solar thermal, geothermal, hydrothermal. Examples, potential availability, lines of technological development
Renewable sources of energy of mechanical origin: wind, tides, sea waves. Examples and potential availability, lines of technological development.
Hydroelectric energy. Power output from a hydroelectric basin. Impulse turbins and reaction turbines and respective operating ranges
Biomass energy. Energy conversion processes of plant biomass. Selection of biomass coltures for energy production.

Prerequisites

Knowledge of thermodynamics, electromagnetism and structure of matter from the first level degree

Teaching form

Taught class with interactive didactics (4 hours)
Some seminars on specific topics will be organized as parts of the course program, plus some seminar on complementary topics

Textbook and teaching resource

John Andrews, Nick Jelley. Energy Science: Principles, Technologies, and Impacts. Oxford University Press, 2017
Bob Everett, Energy Systems and Sustainability: Power for a Sustainable Future. OUP Oxford, 2012
Ibrahim Dincer, Calin Zamfirescu. Sustainable Energy Systems and Applications. Springer Science 2011
Tushar K. Ghosh, Mark A. Prelas. Energy Resources and Systems: Volume 2: Renewable Resources. Springer Business & Economics 2011
Lecture notes.

Semester

Second semester

Assessment method

Presentations held by students. Written report, on topics and insights inherent to the course.

Such seminars can be related to
IN-DEPTH ANALYSIS OF A SCIENTIFIC ARTICLE (presentation of topics not covered in class);
CASE ANALYSIS (Description of a situation or real example whose interconnections are analysed between the different elements/variables in the light of one or more theoretical paradigms);
PROJECT WORK (Development of an original project starting from a simple idea or from the analysis of an existing case).

Interview.
Oral examination - level of understanding of the course topics.

No intermediate evaluation will be organized

Office hours

Monday - Friday by appointment

Sustainable Development Goals

AFFORDABLE AND CLEAN ENERGY