UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Energy Physics

2122-1-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.

Renewable energy sources: principles, sources and technologies

Fossil fuels: formation, reserves, combustion elements and calorific value.

Introduction to nuclear energy.

Nuclear fission.

Nuclear Fusion.

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.

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.

Solar photovoltaic. Generalities on inorganic solar cells. Semiconductors. Silicon cells. Advanced technologies for efficiency optimization

Fossil fuels: formation, reserves, combustion elements and calorific properties

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. Progress in fusion. Research frontiers towards the thermonuclear reactor.

Overview of electricity distribution networks and storage systems.

Energy mix and sustainability

Prerequisites

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

Teaching form

Taught class

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

Slides of the lectures

Semester

Second semester

Assessment method

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

Interview.

Office hours

After appointment by phone or email