UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Geoenergy

2526-2-F7401Q078

Aims

Provide a broad framework of knowledge to geologists to address the emerging issues in the field of geoenergy and sustainability

Contents

The course will cover the basic aspects regarding the problems of research and exploitation of energy resources with hints about the associated risks.
The course will focus on the following topics:

- Introduction to renewable energy resources
- Thermogeology and heat pumps
- Deep geothermal energy
- Shallow geothermal energy
- Reservoir (hydrocarbon) geology
- Underground gas/CO2 storage

Detailed program

General definitions.

General introduction to energy resources

- Energy demand and consumption

- Renewable energies

Introduction to geothermal resources, geothermal systems in low, medium and high enthalpy. The thermal field of the Earth. Sources of thermal energy within the Earth. The geothermal gradient. Conductivity contrasts. Effects of non-uniform temperatures to the surface on temperature profiles. Temperature distribution within the Earth and the Geothermal maps. Thermal properties of the rocks and fluids conductivity, capacity, diffusivity. The impact of high temperature and pressure on fluids. Measurement of the thermal field, instrumentation, methods. Temperature anomalies and association with natural phenomena (hot springs, geysers, volcanoes, mud volcanoes). Interpretation of thermal measurements. Concepts, classification and chemistry of geothermal systems. Development of a geothermal model. Analysis of geothermal systems. EGS: enhanced geothermal systems, hot dry rocks, techniques for improving the performance of reservoir rocks

Thermal analysis in hydrology (thermogeology). Ground source heat pumps systems: open- and closed-loop systems. Systems of heat pumps in open and closed loops. Impacts on water quality. Legislation. Water flow and heat transport Storage heat, specific capacity and thermal, heat transport by advection, conduction, convection. Heat exchangers. Estimation of the potential heat of a shallow unconfined aquifer. Analytical solutions for closed and open systems. Numerical solutions. Operation in the short and long term. Methods of investigation.

Oil Gas - Reservoir rocks. Conceptual models of oil and gas reservoirs. Geometric, physical and mechanical properties of reservoir rocks. Geological key-factors. Tools and techniques for characterization. Stratification of fluids in a reservoir. Multi-fluid circulation in oil and gas deposits in porous rocks and fractured rock masses. Reservoir properties and oil/gas recovery methods. Geomechanics applied to the extraction of hydrocarbons (drilling, stability, stresses in a reservoir, improvement techniques). Unconventional resources: Tight reservoirs, Shale oil, Shale Gas, Fracking, Gas Hydrates (GH).

CO2 storage and natural gas. Characterization of material properties. Modeling Methods. Tests in the laboratory, and on-site monitoring. Micro-induced seismicity. Techniques of Geophysical Research

Prerequisites

Basic concepts of:

- physics
- hydrogeology
- geomechanics
- structural geology

Teaching form

12 two-hour lectures, in person, Delivered Didactics

Textbook and teaching resource

Course slides

Semester

Second

Assessment method

Written exam:

- multiple choice questions
- open-ended questions
- interpretation of graphs

Office hours

Sustainable Development Goals

AFFORDABLE AND CLEAN ENERGY | SUSTAINABLE CITIES AND COMMUNITIES | CLIMATE ACTION