



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## COURSE SYLLABUS

### Geoenergy

2122-2-F7401Q078

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#### Aims

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

#### Contents

Energy resources are one of the most important factors for human activity and consumption of these sources has an immediate impact on the living conditions but also on the equilibrium and evolution of our planet.

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

#### Detailed program

Main contents of this course are:

- General introduction to energy resources
- Energy demand

Conceptual models of 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
- Geomechanics applied to the extraction of hydrocarbons (drilling, stability, stresses in a reservoir, improvement techniques)
- Unconventional resources

#### Introduction to geothermal resources, geothermal systems in low, medium and high enthalpy

- The thermal field of the Earth. A brief history of geothermal energy. 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. Thermal surveys in oil exploration. Thermal analysis in hydrology.
- 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.
- EGS: enhanced geothermal systems, hot dry rocks, techniques for improving the performance of reservoir rocks

#### CO<sub>2</sub> 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

Evaluation of radioactive waste repositories

### **Prerequisites**

none

### **Teaching form**

Lessons

### **Textbook and teaching resource**

all the lectures material can be downloaded from the elearning site

### **Semester**

Second

### **Assessment method**

Written

### **Office hours**

