CIVIL-429

Reservoir mechanics for geo-energy and the environment

Lecampion Brice

Cursus	Sem.	Type
Civil Engineering	MA1, MA3	Opt.
Mechanics		Obl.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	During the semester
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

This course introduces the concepts required to develop fluid-filled porous reservoirs in subterranean formation for a number of industrial applications. It covers the effects of fluid withdrawal and injection on in-situ rock stresses and deformation, well stimulation, deep drilling etc.

Content

- Introduction to geo-energy & the different types of subterranean reservoirs
- Rock geo-mechanical characterization & in-situ stress characterization at different scales
- Deep well construction
- Poroelasticity & flow in deformable fractures
- Fluid flow around a well, pore-pressure diffusion, interference between wells, introduction to reservoir management.
- Effects induced by fluid withdrawal and/or injection: fault re-activation, induced seismicity, surface deformation, cap-rock integrity, un-controlled fracturing.
- Hydraulic fracturing for well stimulation.
- Introduction to numerical methods in geomechanics
- Applications to conventional and unconventional hydrocarbon resources, deep geothermal systems and CO2 geological storage.

Keywords

geo-energy, energy, geotechnical engineering, poromechanics, fluid flow, fractures, wells

Learning Prerequisites

Required courses

Continuum mechanics (solid and fluid)

Recommended courses

Geomechanics, groundwater flow, soil mechanics, rock mechanics, fracture mechanics

Important concepts to start the course

good knowledge of continuum mechanics

Learning Outcomes

By the end of the course, the student must be able to:

- understand the necessary steps required to develop a geo-mechanical model of the sub-surface
- evaluate the impact of fluid withdrawal and/or injection on sub-surface stresses and deformation (notably the risks of large induced seismicity)
- Recognize and discuss the uncertainties related to the sub-surface
- Understand the step of well construction and completion
- evaluate when and how to stimulate a well by hydraulic fracturing
- discuss the initiation of hydraulic fractures and their different regimes of propagation

Transversal skills

- Access and evaluate appropriate sources of information.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Demonstrate the capacity for critical thinking
- Take responsibility for environmental impacts of her/ his actions and decisions.

Expected student activities

A project will be assigned at the beginning of October and run through the end of the semester. It will count for 70% of the grade. It will involve the following steps: i) putting a real engineering problem in mathematical form (physical modeling), ii) discussing order of magnitude via dimensional analysis , iii) solving the problem (numerically or analytically) and iv) discuss the relevance of the results for practice.

Assessment methods

100% during the semester (written tests 30%, project 70%)

Supervision

Office hours	No
Assistants	Yes
Forum	Yes