**Reservoir geo-mechanics engineering**

Lecampion Brice

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<tr>
<th>Cursus</th>
<th>Sem.</th>
<th>Type</th>
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<tr>
<td>Génie civil</td>
<td>MA1, MA3</td>
<td>Opt.</td>
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<td>Mécanique</td>
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<td>Obl.</td>
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- **Language**: English  
- **Credits**: 3  
- **Session**: Winter  
- **Semester**: Fall  
- **Exam**: During the semester  
- **Workload**: 90h  
- **Weeks**: 14  
- **Hours**: 3 weekly  
  - Lecture: 2 weekly  
  - Exercises: 1 weekly  

**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  
- Introduction to numerical methods in geomechanics (FE/FD algorithms for hydro-mechanical coupling)  
- Deep well construction  
- Poroelasticity & flow in deformable fractures  
- Extension to thermal effects  
- 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.  
- Introduction to hydraulic fracturing for well stimulation.  
- 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)  
- Geomechanics

**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:

- Contextualise - understand the necessary steps required to develop a geo-mechanical model of the sub-surface
- Assess / 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
- Contextualise - understand the step of well construction and completion
- Assess / 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 group project will be assigned mid-october and run through the end of the semester. It will count for 50% of the grade. It will involve the following steps: i) solving analytically/numerically a simplified configuration linked to a real engineering problem, ii) discussing order of magnitude via dimensional analysis, iii) and discuss the relevance of the results for practice.

Assessment methods

50% Project during the semester
50% Final oral exam

Supervision

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<th>Office hours</th>
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<tr>
<td>Assistants</td>
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<td>Forum</td>
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