CIVIL-425

Continuum mechanics and applications

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Cursus	Sem.	Type
Civil Engineering	MA2, MA4	Opt.
Mechanics		Opt.

Language of teaching	English
Credits	6
Session	Summer
Semester	Spring
Exam	Oral
Workload	180h
Weeks	14
Hours	**5 weekly**
Lecture	3 weekly
Exercises	2 weekly
Number of positions	

Summary

This course covers the fundamentals of continuum mechanics theory at the level of the graduate level and provide modern examples of applications in mechanics of fluids, solids and structures. It is adequate for students with a background in civil engineering, mechanical or material

Content

The goal of this course is to introduce the student to the theory of continuum mechanics. It is based on the content of classical textbooks of continuum mechanics such as the book of Malvern. The course is offered at the level of graduate course and gives a solid theoretical basis for students aiming to master theory and numerical modeling (finite-element method).
The course is divided in two modules. The first part covers the fundamentals of continuum mechanics:

- Kinematics of deformation (and in particular finite kinematics)
- Conservation laws (lagrangian and eulerian form): conservation of mass, linear and angular momentum balance, principle of virtual work, energy, first and second law of thermodynamics.

The second module covers constitutive theory and applications, include linear and non-linear elasticicity, visco elasticity, plasticity, Newtonian and non-Newtonian fluids, flow in porous media, shock waves in materials.
Course organization
6hrs per week (**6** credits): 3 hours lectures / 3 hours exercices. Students will also present in class a modern application of conitnuum mechanics.

Learning Prerequisites

Required courses

- Continuum mechanics (e.g. CIVIL-225)
- Finite Elements (e.g. CIVIL-321)

Important concepts to start the course

- Linear algebra, tensor analysis, numerical analysis

- introductory course in mechanics of solids and fluids

Learning Outcomes

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

- Conceptualize and formalize a boundary value problem in continuum mechanics.
- Master the fundamental principles of continuum mechanics.

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
- Summarize an article or a technical report.

Teaching methods

3 hours lectures - either ex-cathedra or to discuss course notes for the week would need to be read prior to the class.
3 hours in exercise room or at home for homework - focused on the resolution of a problem previously described during the lecture.

Expected student activities

Student will be expected to be pro-active and read course material in advance. They will also need to finalize by themselves the solution of the problems given every week.

Assessment methods

During the semester
1 class presentation (analysis of a particular problem/application of continuum mechanics) (30% of the grade)
Oral exam (70% of the grade)

Supervision

Office hours	No
Assistants	Yes
Forum	Yes
Others	Moodle etc

References

- Course notes & articles given during lectures
- Introduction to continuum mechanics (Malvern)