ME-482

# Biomechanics of the musculoskeletal system

Pioletti Dominique

| Cursus | Sem. | Type |
|---|---|---|
| Biomedical technologies minor | E | Opt. |
| Life Sciences Engineering | MA2, MA4 | Opt. |
| Mechanical engineering minor | E | Opt. |
| Mechanical engineering | MA2, MA4 | Opt. |

| | |
|---|---|
| Language of teaching | English |
| Credits | 5 |
| Withdrawal | Unauthorized |
| Session | Summer |
| Semester | Spring |
| Exam | During the semester |
| Workload | 150h |
| Weeks | 14 |
| **Hours** | **3 weekly** |
| Courses | 2 weekly |
| Exercises | 1 weekly |
| **Number of positions** | |

**It is not allowed to withdraw from this subject after the registration deadline.**

## Summary

The basis for a mechanical description of the musculoskeletal system are presented. This description is based on the concepts of solid mechanics, physiology and anatomy of the musculoskeletal system. Concrete examples of the development of implants are also covered.

## Content

Biomechanics at the body level (functional anatomy; joint kinematics; forces in the joints). Biomechanics at the tissue level (large deformations; passive and active constitutive laws; identification; laws of evolution). Biomechanics in clinical applications (orthopaedics biomechanics; traumatology, implant development). Mini-project in group.

## Keywords

Constitutive laws, Identification, Orthopedics

## Learning Prerequisites

### Recommended courses

- Elementary knowledge in physiology
- Master the concepts of conservation laws

## Learning Outcomes

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

- Explain the link between the physiology and the mechanical properties of a tissue, B2
- Compute the kinematics and the forces in articulations, B3
- Identify the mechanical behaviour of tissues and fluids from experimental data, B5
- Describe the feedback loop that, starting from a mechanical signal translated into a chemical signal, allows for the adaptation of the mechanical properties of tissues, B9
- Compare the range of validity of different constitutive laws, B7
- Describe the procedure to identity a constitutive law, B14

## Transversal skills

- Communicate effectively with professionals from other disciplines.
- Access and evaluate appropriate sources of information.
- Write a scientific or technical report.
- Make an oral presentation.

## Teaching methods

The course is organised as theoretical sessions and includes the resolution of exercises and the realization of a mini-project within a group.

## Expected student activities

Exercises to do. Realization of a mini-project in groups of 4, oral presentation of the project and a report of maximum 15 pages.

## Assessment methods

- 1/3 of the grade based on oral presentation mini-project in group on video (4 students per group)
- 1/3 based on the written report of the mini-project (4 students per group)
- 1/3 based on a written report making connection between the teaching given during the class and the development of the mini project on 3 to 5 page (each student has to write a report)

## Supervision

| | |
|---|---|
| Office hours | Yes |
| Assistants | Yes |
| Forum | No |

## Resources

### Bibliography

The course material can be downloaded from the moodle website (http://moodle.epfl.ch/course/view.php?id=1201).
1. Skeletal Tissue Mechanics, B. Martin, et al., Springer, 1998 (ISBN 0-387-98474-7)
2. Continuum mechanics, Spencer, Longman, 1992 (ISBN 0-582-44282-6)

### Ressources en bibliothèque

- Continuum mechanics / Spencer A
- Skeletal Tissue Mechanics / Martin B

### Moodle Link

- http://moodle.epfl.ch/course/view.php?id=1201