

BIO-687

Engineering of musculoskeletal system and rehabilitation

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Cursus	Sem.	Type
Biotechnology and Bioengineering		Opt.
Mechanics		Opt.
Robotics, Control and Intelligent Systems		Opt.

Language of teaching	English
Credits	3
Session	
Exam	Multiple
Workload	90h
Hours	28
Lecture	21
Practical work	7
Number of positions	12

Remark

Next time Fall 2024

Summary

This course presents today research questions and methods associated to the musculoskeletal system, its pathologies, and treatment.

Content

The course is divided in 5 modules given in the format of lectures, plus half a day in the university hospital of Lausanne (CHUV) to (optionally) attend a surgery. The first module includes theoretical background on biomechanics of musculoskeletal system, numerical methods, and the analysis of movement. The next three modules are related to a specific joint. The last module is devoted to tissue engineering. Lectures from both engineering and medical points of view will be presented.

1. General concept of musculoskeletal system biomechanics and locomotion.

- 1.1 Introduction to biomechanics
- 1.2 General numerical concepts
- 1.3 Kinematics and locomotion evaluation

2. Hip and knee

- 2.1 Clinical aspects
- 2.2 Patient-specific model
- 2.3 Bone remodeling
- 2.4 3D gait analysis using kinematics and spatio-temporal parameters

3. Shoulder

- 3.1 Clinical aspects
- 3.2 CT & MRI, FE modeling
- 3.3 3D functional evaluation with functional test and long-term monitoring

4. Tissue engineering

- 4.1 Biomechanics in tissue engineering
- 4.2 Bone and cartilage tissue engineering
- 4.3 Biomechanics in tissue engineering

5. Ankle

- 5.1 Clinical aspects
- 5.2 Experimental and numerical models
- 5.3 3D gait analysis with ground reaction force and inverse dynamics

6. Attend a total joint replacement surgery (optional)

7. Project presentations

Note

This course is limited to 12 participants.

Lecturers (EPFL): Dominique Pioletti, Alexandre Terrier

Lecturers (CHUV): Xavier Crevoisier, Robin Martin, Julien Favre, Patrick Goetti, Alexander Antoniadis

Assessment methods

In parallel to lectures and hands-on lab, the students will acquire this knowledge by doing a mini-project. The project is approved in a midterm session, and is evaluated by an oral presentation at the end of the semester.

Resources

Moodle Link

- <https://go.epfl.ch/BIO-687>