BIO-687

Engineering of musculoskeletal system and rehabilitation

Aminian Kamiar, Antoniadis Alexander, Crevoisier Xavier, Martin Robin, Pioletti Dominique, Terrier Alexandre, Various lecturers , Vauclair Frédéric

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	**42**
Courses	28
TP	14
Number of positions	**12**

Frequency

Every 2 years

Remark

Next time Fall 2020

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, 2h, by Dominique Pioletti
1.2 General numerical concepts, 2h, by Alexandre Terrier
1.3 Kinematics and locomotion evaluation, 2h by Kamiar Aminian

2. Hip and knee
2.1 Clinical aspects, 1h by Alexander Antoniadis
2.2 Patient-specific model, 1h by Alexandre Terrier
2.3 Bone remodeling, 1h by Dominique Pioletti
2.4 3D gait analysis using kinematics and spatio-temporal parameters, 1h, by Kamiar Aminian

3. Shoulder
3.1 Clinical aspects, 1h by Frédéric Vauclair
3.2 CT & MRI, FE modeling, 2h, by Alexandre Terrier
3.3 3D functional evaluation with functional test and long-term monitoring, 2h, by K Aminian

4. Tissue engineering
4.1 Biomechanics in tissue engineering, 1h, by Dominique Pioletti
4.2 Bone and cartilage tissue engineering, 1h by Robin Martin
4.3 Biomechanics in tissue engineering, 1h, by Dominique Pioletti

5. Ankle
5.1 Clinical aspects, 1h by Xavier Crevoisier

5.2 Experimental and numerical models, 1h, by Alexandre Terrier
5.3 3D gait analysis with ground reaction force and inverse dynamics,1h by Kamiar Aminian

6. Attend a total joint replacement surgery (optional), 4h

7. Project presentations, 2h, with EPFL lecturers

Note

This course is limited to 12 participants.

Lecturers (EPFL): Kamiar Aminian, Dominique Pioletti, Alexandre Terrier
Lecturers (CHUV): Xavier Crevoisier, Robin Martin, Frédéric Vauclair, 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.