EPFL

BIO-687   **Engineering of musculoskeletal system and rehabilitation**

Aminian Kamiar, Pioletti Dominique, Terrier Alexandre, Various lecturers

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

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 treatement. In paralell to lectures and hands-on lab, the students will acquire this knowledge by doing a mini-project.

Content

The course is divided in 5 modules given in the format of lectures, plus one morning in the hospital to attend a surgery. The first module includes theoretical background on biomechanics of musculoskeletal system and the analysis of movement. The next 3 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, conservation laws + constitutive equations (linear, non-linear, ….) (DP: 2 hrs)
 1.2 General numerical concepts (FE, µFE, …) (AT: 2 hrs)
 1.3 Kinematics and locomotion evaluation (KA: 2 hrs)

2) Hip/knee
 2.1 Knee and hip arthritis, ligament ruptures, knee/hip implant, ligament surgery (OG: 1 hr)
 2.2 Knee, hip, ligament modeling, patient specific model, implant design comparison (AT: 1 hr)
 2.3 Bone remodeling, local drug delivery (mCT & mFE) (DP: 1 hr)
 2.4 3D gait analysis using kinematics and spatio-temporal parameters (KA: 1 hr)

3 Shoulder
 3.1 Shoulder anatomical analysis, disease (rotator cuff tears, osteoarthritis), its surgical treatments (AF: 1 hr)
 3.2 CT & MRI image for modeling, FE modeling (AT: 2 hr)
 3.3 3D functional evaluation with functional test and long-term monitoring (KA: 2 hr)

4) Tissue engineering
 4.1 Biomechanics in tissue engineering (DP: 1 hr)
 4.2 Bone and cartilage tissue engineering (RM: 1 hr, DP: 1 hr)

5) Ankle
 5.1 Ankle diseases (foot flat, arthritis, tendinopathy), its treatments (XC: 1 hr)
 5.2 FE modeling, experimental (cadaveric) data to validate FE, revision prostheses (AT: 1 hr)
 5.3 3D gait analysis with ground reaction force and inverse dynamics (KA: 1 hr)

6) Possibility to attend a total joint replacement surgery (3h)
 2 personnes per opration, see with MD

7) project presentataion with all (3h)