UCLouvain

lgbio1114

2020

Artificial organs and rehabilitation

Due to the COVID-19 crisis, the information below is subject to change, in particular that concerning the teaching mode (presential, distance or in a comodal or hybrid format).

5 credits	30.0 h + 30.0 h	Q2

Teacher(s)	Jacquet Luc-Marie ;Lefèvre Philippe ;Ronsse Renaud ;
Language :	French
Place of the course	Louvain-la-Neuve
Main themes	This course aims at introducing existing artificial organs, prostheses, and rehabilitation systems, focusing on their goals, working principles, and limitations. It further stimulates the student's innovation skills through the deep understanding of the global problem of interfacing a human with such a device.
Aims	Regarding the learning outcomes of the program of "Master in Biomedical Engineering", this course contributes to the development and the acquisition of the following learning outcomes: AA1.1, AA1.2, AA1.3, AA2.1, AA2.4, AA2.5 AA3.1, AA3.2, AA3.3, AA4.2, AA4.3, AA4.4 AA5.2, AA5.3, AA5.5, AA5.6 AA6.1, AA6.3 **More precisely, at the end of this course, students will be able to:** a. <u>Disciplinary Learning Outcomes</u> 1. Physiopathology of organs: • Explain the role of an organ in sustaining the biological functions of the whole body, and its functional principle, both in normal and pathological conditions. • Describe and understand the working principle of basic physiological functions (vision, audition, locomotion, movements, etc.). • Understand the consequences of the malfunctioning of an organ or a physiological function, and thus the ultimate objective of the artificial organ or prosthesis. • Describe the expected functionalities of an artificial organ - partial or complete - and prosthesis. 2. Techniques being currently available: • Understand and describe the physical, chemical, or biological principles involved in the context of a particular artificial organ or prosthesis. • Describe the functional modalities of several artificial organs and prostheses, their potential modes of failure, and the safety mechanisms to prevent or fix them with minimal invasiveness for the patient. • Master the basic knowledge about haemocompatibility and the consequences for the optimal functioning of an artificial organ. 3. Perspectives to future developments: • Perceive the research and development trends for the future years. • Imagine improvements or new concepts based on the existing solutions. <u>b) Transversal Learning Outcomes</u> • Take part to a multidisciplinary team in charge of the development, maintenance, and improvement of artificial organs and prostheses. • Discuss a new topic and concept in front of an audience. • Perform a critical analysis of a scientific article. • Propose original solutions to an existing problem. • Realize the preliminary dimensioning of an active prosthesis or a rehabilitation device for movement assistance (problem-based learning, PBL) in a group with other students. - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*

Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Students will be individually evaluated by means of a written examination that will evaluate the capacity to reproduce some reasoning covered in the lectures, as well as their global understanding, by means of a series of short questions. Evaluation of the practical contributions • The lab project will be marked and accounted for in the final evaluation. • The article reading will be marked and integrated in the final evaluation. *Depending on the health situation, the exam can be organized remotely. In this particular case, if a problem is noted in an exam copy (suspicion of fraud or technical problem) or when it is submitted (when downloading or equivalent), an oral exam may be organized in addition and/or in replacement of the written assessment*.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** The course consists of 26 hours of theoretical lectures, containing examples of the covered concepts. The package of practical contributions consists of a critical presentation of a scientific paper; the visit of medical (or medico-technical) services where artificial organs are being used; and a lab project with a haptic device (Hapkit), in a group of students.
Content	This course is an introduction to the medical treatments that resort to the substitution of artificial systems to failing organs, limbs, or physiological systems. For each application, the course will approach the basic anatomy and physiology notions of organs to be replaced, as well as an overview of failure reasons (pathology). Afterwards, the course will present the artificial organs (composition, functioning mode, organism adaptation) along with the therapeutic effects and the limitations to such substitution (side effects and complications). The different applications are grouped according to 3 major themes which are: vital organ substitution (blood flow, cardiac pump, lung, kidney, etc.), passive and active implants, and rehabilitation and assistive robots. Moreover, the course will examine machine organs in medical applications (pumps, actuators, transmission and tightness organs, micro-mechanisms, etc.). The part covering active implants will mainly overview the prostheses and external sensorial devices. The cardiac pacemaker and defibrillators will be exhaustively studied. The course will also introduce sensorial pathologies, cochlear implants and visual prosthesis. Drug pumps and drug delivery systems will be covered in this section. The third part, dealing with rehab and assistive robotics, will cover the most recent developments of robotic solutions to rehabilitation, assistance, or replacement (through prostheses) of the upper- and lower-limb. The main mechanisms governing motor control will be explored in parallel.
Inline resources	Moodle : http://moodleucl.uclouvain.be/course/view.php?id=8998
Other infos	/
Faculty or entity in charge	GBIO

Force majeure

Teaching methods	The "hapkit" lab will be done face-to-face. Each group of 2 students will be invited to come EITHER on Tuesday morning (8h30-10h30) OR on Wednesday morning (8h30-10h30) in weeks S4, S5, and S6 for this lab.
Evaluation methods	In case of force majeure, the examination will be done remotely via a computer platform.

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Aims
Master [120] in Chemical and Materials Engineering	KIMA2M	5		
Minor in Biomedical Engineering	LMINOGBIO	5		
Specialization track in Biomedical Engineering	FILGBIO	5		
Master [120] in Chemistry and Bioindustries	BIRC2M	5		
Minor in Engineering Sciences : biomedical (only available for reenrolment)	MINGBIO	5		