UCL Université catholique de Louvain

LGBIO2070

2014-2015

Artificial organs and rehabilitation

5.0 credits	30.0 h + 30.0 h	2q

Teacher(s) :	Lefèvre Philippe ; Jacquet Luc-Marie ; Ronsse Renaud ;
Language :	Français
Place of the course	Louvain-la-Neuve
Inline resources:	> http://icampus.uclouvain.be/claroline/course/index.php?cid=LGBIO2070
Prerequisites :	None
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. Disciplinary Learning Outcomes 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. b. Transversal Learning Outcomes -- 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 :	Students will be individually evaluated by means of a mixed exam: -- The oral part (preceded by written preparation) will evaluate the particular objectives listed above. One main question will be asked, as a starting point to explore the mastering of various topics. -- The written part will evaluate the capacity to reproduce some reasoning covered in the lectures, such as their global understanding, by means of a series of short questions. Evaluation of the practical contributions -- The PBL project (dimensioning of prosthesis or something else) will be marked and accounted for in the final evaluation. -- The article reading will not be marked, since it is aiming at illustrating the theory and improving some skills that are evaluated at the exam. Nevertheless, a positive or negative feeling might be influential.
Teaching methods :	The course consists of 30 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 small PBL project, 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 or physiological systems. For each application, the course will approach the basic anatomy and physiology notions of organs to replace, as well as an overview of failure reasons (pathology notions). 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 last 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.
Bibliography :	Slideshows being presented during the theoretical lectures, together with the corresponding illustrations, are available on iCampus. So are scientific articles that can be used for student presentations.
Other infos :	/
Cycle and year of study :	> Master [120] in Biomedical Engineering > Master [120] in Mathematical Engineering > Master [120] in Computer Science and Engineering > Master [120] in Electrical Engineering > Master [120] in Chemical and Materials Engineering
Faculty or entity in charge:	GBIO