UCLouvain

lgbio2060

2024

Modelling of biological systems

5.00 credits	30.0 h + 30.0 h	Q1

Teacher(s)	Kalidindi Hari Teja (compensates Lefèvre Philippe) ;Lefèvre Philippe ;Opsomer Laurent (compensates Lefèvre Philippe) ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	Students need to master the common core skills described in the civil Engineering Bachelor's programme
Main themes	Vision and other sensory systems, the oculomotor and other motor systems and their mathematical modeling.
Learning outcomes	**At the end of this learning unit, the student is able to :** With respect to the AA referring system defined for the Master in Biomedical Engineering, the course contributes to the development, mastery and assessment of the following skills : • AA1.1, AA1.2, AA1.3 • AA2.2 • AA3.1, AA3.2 • AA4.3 • AA5.3, AA5.5, AA5.6 • AA6.3 **More precisely, at the end of this course, students will be able to:** Disciplinary Learning Outcomes 1 • Understand basic knowledge about biological systems in order to model them. • Understand and be able to model different types of biological systems by using appropriate modeling tools. • Choose appropriate models and argue about these choices depending on the modeling application. • Make a critical analysis about the relevance and interest of mathematical models of biological systems in their capacity to predict new experimental results and inspire original experimental protocols. • Use softwares and computers to implement and simulate mathematical models of biological systems. T ransversal Learning Outcomes • Make a critical analysis of the scientific literature devoted to the development of original mathematical models of biological systems. • Make a concise and critical presentation of a scientific article related to mathematical models of biological systems.
Evaluation methods	The evaluation of the students will be based on two parts: 30% of the final mark will be based on the evaluation of homeworks done in small groups of students during the semester and 70% of the final mark will be based on the individual exam during the session (written or oral). Continuous assessment comprises a number of assignments, which will result together in a single overall mark, communicated after the correction of all assignments. Failure to comply with the methodological guidelines set out on Moodle, particularly with regard to the use of online resources or collaboration between students, for any part of the project, will result in an overall mark of 0 for the continuous assessment. The use of generative AI software such as chatGPT is authorized for assistance in writing the documents requested as part of this project. However, it must be clearly and completely indicated in the document(s) concerned.
Teaching methods	The course is made of lectures given by the teachers. The course is also made of practical exercises of mathematical modelling (data analysis and modelling) leading to homeworks as well as the critical analysis and presentation of scientific publications dedicated to mathematical models of biological systems.
Content	In the field of modeling of sensory and motor physiological systems, this course will present how a mathematical model is built in the biomedical field, starting from the laws of nature. It will describe how its elaboration is always closely linked to experiment work aiming at obtaining data on which the model will be based. The model will be presented as a tool that allows explaining basic mechanisms of biological systems and making predictions of the responses of the system in new experimental conditions. The different steps of the model development will be presented: initial observations, hypotheses, model testing and validation. Different types of models will be described and illustrated, for instance: deterministic versus stochastic, static versus dynamic or chaotic, parametric

	versus non-parametric, lumped versus distributed. These notions will be illustrated by mathematical models in the biomedical field as for instance physiological models of eye movements and the coordination between different body segments (with a particular focus on clinical applications and the comparison across different species).
Inline resources	Moodle http://moodleucl.uclouvain.be/course/view.php?id=8449
Bibliography	Les documents du cours sont disponibles sur Moodle.
Faculty or entity in charge	GBIO

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Biomedical Engineering	GBIO2M	5		
Master [120] in Chemistry and Bioindustries	BIRC2M	5		
Master [120] in Computer Science and Engineering	INFO2M	5		
Master [120] in Computer Science	SINF2M	5		
Master [120] in Electro-mechanical Engineering	ELME2M	5		
Master [120] in Mathematical Engineering	MAP2M	5		
Master [120] in Energy Engineering	NRGY2M	5		