GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2020-2021

Modeling in Medicine and Biomedical Engineering: Case Studies (E092913)

Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.

Course size (nominal values; actual values may depend on programme)

Credits 3.0	Study time 90 h	Contact hrs 30.0 h

Course offerings and teaching methods in academic year 2020-2021

A (semester 1)	English	Gent	microteaching	7.5 h

Lecturers in academic year 2020-2021

Segers, Patrick	TW06	lecturer-in-charge
Debbaut, Charlotte	TW06	co-lecturer

Offered in the following programmes in 2020-2021	crdts	offering
Master of Science in Biomedical Engineering	3	A
International Master of Science in Biomedical Engineering	3	A
Master of Science in Biomedical Engineering	3	A

Teaching languages

Dutch, English

Keywords

(Study of) bio-fluids, modeling heat and mass transfer in biomedicine, multi-scale models, medical imaging

Position of the course

The role of engineers in the biomedical field has vastly increased the past decades, particularly supporting ongoing research in human physiology and medical technology (e.g. medical imaging, medical devices) via experimental and computer modeling. However, most biomedical research problems are of a complex nature, comprising a broad spectrum of different physical disciplines like fluid mechanics, tissue mechanics, heat and mass transfer problems, etc… Hence, advancing the knowledge and technology in the domain of biomedical engineering requires translating these multi-physics problems at hand into appropriate experimental and/or computational models.

Contents

Based on recently published research papers, a number of advanced modelling applications are studied, in the domain of:

- Blood flow and bio-fluid mechanics (e.g. blood flow in the cardiovascular system or extracorporeal circulations, lymphatic flow, air flow in the lungs or medical devices, flow through heart valves, …)
- Heat (e.g. ablation techniques) and mass transport (lipid transport in the vascular wall, microfluidic devices, ….)
- Electrophysiology: modeling electrical conductance and currents in the heart to understand electrophysiological disorders and to support pacemaker design
- Multi-scale modeling: modeling organs and systems from the micro to macroscale
- Molecular modeling, with attention for modeling the physical-chemical behaviour of oxygen, proteins and/or other biomolecules or pharmaceuticals at atom level;
- Multi-physics models to support the development of medical imaging, e.g. generating synthetic ultrasound data of arterial blood flow and wall motion and deformation
- …

Topics are introduced by the lecturer based on one or more recent scientific papers, and the necessary theoretical background to understand the problem and methodology and to solve the problem is provided. This introduction is then complemented by practical exercises and/or discussion of related papers by the students (suggested to the students or their own choice). At the end of the course, students will discuss one or

more papers of their own choice in detail.
Besides the above described literature-based assignments and sessions, students work on their own research project. Students get computer code that they should use in a creative way to answer a research question or hypothesis.

Initial competences

physics, transport phenomena

Final competences

1. Perform a literature search using scientific literature data bases (pubmed, web of science)
2. Objectively and critically assess the results of others, and to independently formulate and defend your opinion
3. Report orally and graphically on a scientific topic in English
4. Analyse complex multidisciplinary biomedical problems based on (recent) scientific research
5. Develop a logically structured, technologically realisable and ethically justified research plan
6. Acquire insight into complex biomechanical, biological or physiological processes by means of advanced models and paradigms

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Guided self-study, microteaching, online discussion group, self-reliant study activities, online lecture, online project

Extra information on the teaching methods

The course will take place online with live teaching and discussion. The course requires active participation and interaction of the student.

Learning materials and price

Copy of slides, research papers, software

References

Course content-related study coaching

Evaluation methods

continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Examination methods in case of periodic evaluation during the second examination period

Examination methods in case of permanent evaluation

Written examination with open questions, participation, assignment

Possibilities of retake in case of permanent evaluation

examination during the second examination period is not possible

Extra information on the examination methods

Assessment of presentations, report and presentation of the modeling assignment, assessment of open questions.

Calculation of the examination mark

25% presentation on a topic addressed within one of the modules
25% presentation of freely chosen topic (but relevant for the course)
25% assessment modelling assignment
25% assessment of answers to the module-related open questions