GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2018-2019

Architecture and Fabrication of Biomedical Microsystems (E092990)

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

Credits 3.0	Study time 90 h	Contact hrs	27.5 h

Course offerings and teaching methods in academic year 2018-2019

A (semester 2)	English	lecture	17.5 h
		practicum	5.0 h
		project	5.0 h

Lecturers in academic year 2018-2019

Op de Beeck, Maaike	TW06	lecturer-in-charge

Offered in the following programmes in 2018-2019	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

English

Keywords

Biomedical microsystems, wearable devices, implantable devices, biocompatibility and biostability of materials and devices, device miniaturization, advanced microsystem fabrication and packaging technologies, microfluidics, cleanroom, telemetry and powering of implants.

Position of the course

The aim of the course is to provide an overview of the architecture and fabrication technologies of wearable and implantable electronic devices. Fabrication technologies originally developed for IC fabrication as well as technologies for component integration and device packaging will be discussed. Important properties for biomedical devices such as biocompatibility and biostability of materials/ devices are studied. The regulatory aspects of medical devices get attention, as well as the corresponding risk analysis performed from the start of the device development.
The course will bring insights in the basic principles regarding architecture and fabrication of wearable and implantable devices, including current issues and future trends.

Contents

- Biocompatibility and biostability of materials / devices
  - Foreign body reaction
  - Biocompatibility, mechanical and thermal compatibility and related device/material testing
  - Biostability
  - Biofilms and infections on implants
  - MRI compatibility of implants
- Regulatory aspects, risk analysis, device safety and security
- Powering and telemetry options, consequences for device design and fabrication
- Fabrication technologies for electronic microsystems
  - Oxidation, ion implantation
  - Dry deposition techniques, wet deposition techniques
  - Lithography and etch (wet – dry), chemical mechanical polishing (CMP)
  - Importance of cleaning, impurity control
  - Device testing (functionality tests)
  - Electronic chip packaging technologies + PCB integration
- Clean rooms for device fabrication, laboratories for biomedical investigation

- Microfluidics
  - Microfluidic operators and dedicated fabrication technologies
- Fabrication of wearable/implantable microdevices
  - Biomimetic integration technologies (ultrathin / flexible / stretchable devices)
  - Miniaturization of devices: importance and methodologies
- Case studies
  - Discussion of several implantable devices regarding architecture and fabrication, remaining device/fabrication issues, trends for improvements
- Clean room and laboratory visit
  - Demonstration of various fabrication technologies
  - Evaluation/ analysis of fabrication results
- Project work (small groups)
  - Analysis of technical paper about medical device architecture or fabrication
  - Short summarizing presentation in concluding seminar

Initial competences

Basic knowledge of physics, electricity, chemistry - further no specific prior knowledge is required.

Final competences

1 Knowledge of the basic architecture of most common medical microsystems.
2 Understanding of this basic device architecture (why is the device made from certain materials, why has the device a particular size and shape, etc.).
3 Knowledge of the basic fabrication technologies for electronic components including basic rules of conduct in cleanrooms.
4 Knowledge of the basic integration technologies to fabricate wearable / implantable devices.
5 Skills for the selection of most suitable integration technology regarding the envisaged functionality of the medical device.
6 Basic understanding of biocompatibilty and biostability of materials and devices, including basic knowledge of corresponding test procedures. Understanding their contextuality (influence of duration and type of body contact).
7 Knowledge of the basic requirements for a medical microsystem regarding functionality, and patient safety.
8 Basic knowledge about regulatory aspects of medical devices and corresponding risk assessment.
9 Understanding the issues related to current medical devices, as well as research topics and future trends to address these issues.
10 Basic insight in the level of difficulty when making microsystems, understanding that many details are very important when fabricating medical microsystems.
11 Skills regarding the understanding and critical analysis of technical publications regarding medical device architecture and fabrication. Skills regarding summarizing and presenting (using powerpoint) a technical paper.

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

Lecture, practicum, project, seminar

Extra information on the teaching methods

Plenary lecture, laboratory session, project work in small groups with plenary introduction and concluding seminar.

Learning materials and price

Syllabus en powerpointslides staan ter beschikking.

References

Course content-related study coaching

Evaluation methods

end-of-term evaluation and continuous assessment

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

Oral examination

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

Oral examination

Examination methods in case of permanent evaluation

Participation, report

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

End-of-term evaluation (= oral examination with written preparation, closed book) and continuous assessment (= laboratory report and group presentation of project work).

Calculation of the examination mark

During examination period: oral closed-book exam = 75%
During semester: graded laboratory report; graded oral presentation (frequency: once) = 25%