GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2024-2025

Biomaterials and Biocompatibility (D012551)

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

Credits 8.0 **Study time 240 h**

Course offerings and teaching methods in academic year 2024-2025

A (semester 2)	English	Gent	lecture
			peer teaching

Lecturers in academic year 2024-2025

Dubruel, Peter	WE07	lecturer-in-charge
Dmitriev, Ruslan	GE38	co-lecturer

Offered in the following programmes in 2024-2025	**crdts**	**offering**
Master of Science in Biomedical Sciences	8	A

Teaching languages

English

Keywords

Biomaterials, polymers, metallic biomaterials, ceramic biomaterials, hybrid biomaterials, design, surface engineering, biomedical applications, biocompatibility

Position of the course

The student is provided with knowledge and insights about the development, properties, design, possibilities/limitations and biocompatibility of biomaterials (polymers, metallic and ceramic biomaterials and combinations) for biomedical applications. The potential of (hybrid) biomaterials for the preservation, restoration or replacement of affected or damaged tissues and/or organs. As such, this course provides the base for the course 'Tissue engineering' in the second master year.

Contents

1) Engineering of biomaterials

Synthesis and physico-chemical characterization of biomaterials

Overview of the basic principles for the synthesis of polymers: vinyl polymers, addition and condensation-polymers, ring opening polymerization, biodegradable polymers, hydrogels, chemical modification of polymers. Characterization of polymer properties in the bulk and at the surface.
Chemical and physical properties of ceramic biomaterials (calcium phosphates and cements, bioactive glass, aluminium oxide, zirconium oxide and related materials).
Synthesis, chemical and physical properties of metallic biomaterials (Co-Cr alloys, stainless steel, titanium and alloys, corrosion of metals). Properties of bone tissue. Micropatterning technologies.
Nanomaterials and biopolymer-based materials.

Mechanical properties of biomaterials.

Possibilities/ limitations of the different types of biomaterials.

Design: from standard techniques to 3D printing and hybrid biomaterials

Traditional and new manufacturing techniques (additive manufacturing (rapid prototyping), electrospinning,...), hybrid biomaterials

Surface engineering of polymer biomaterials

Characterisation, imaging and standardisation of biomaterials
Biomaterials as extracellular matrix for 2D and 3D cell culture systems
Sterilization methods and their effect on biomaterial properties

2) Biomaterials in a biological environment
Cytotoxicity and biocompatibility (ISO-norms), cell/biomaterial interactions (cell adhesion and –proliferation), tissue/biomaterial interactions

3) Applications of biomaterials in tissue engineering and regenerative medicine and 3D cell culture systems
Top-down and bottom up tissue engineering. Application of biomaterials in the formation of 3D culture models (organoids, cancer therapy, drug delivery…).

Initial competences

Biomaterials and Biocompatibility builds further on certain final competences of the courses General chemistry, Organic chemistry, Physics, General biochemistry, General physiology, Functional anatomy, Cytology & histology and Functional histology from the bachelor program biomedical sciences.
Having completed successfully the bachelor degree of biomedical sciences or having acquired the relevant ending objectives by other means.

Final competences

1 Knowing the basic principles for the synthesis and development of polymers, metals and ceramic materials for biomedical applications.
2 To determine the properties of biomaterials for specific biomedical applications.
3 To evaluate the development, processing techniques and design for biomaterials.
4 Having knowledge of surface engineering and characterization of polymer biomaterials.
5 Having insights into the possibilities and limitations of the different types of biomaterials.
6 Having insights into the methods to evaluate the cytotoxicity and biocompatibility of biomaterials.
7 Having insights into the biocompatibility of biomaterials.
8 To describe the correlation with in vitro and in vivo applications in medicine.
9 To gain insight in the application possibilities of biomaterials to form complex 3D systems (regenerative medicine, cancer therapy, pharmacy,…)
10 Being able to select literature concerning biomaterials and to evaluate according to scientific value and relevance.

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, Peer teaching

Extra information on the teaching methods

Microteaching: groupswork related to a topic (e.g. 3D bioprinting, heart and blood vessels, musculoskeletal, nerve regeneration,…). Which biomaterials are most suitable for the applications?

Study material

None

References

- Biomaterials: A systems approach to engineering concepts. B. Love. 2017. Elsevier ISBN: 978-0-12-809478-5.
- Fundamentals in biomaterials. V. Hasirci, N. Hasirci. Springer 2018. ISBN 978-1-4939-8854-9.

Course content-related study coaching

After making an appointment

Assessment moments

end-of-term and continuous assessment

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

Written assessment with multiple-choice questions, Written assessment with open-ended questions, Written assessment

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

Written assessment with multiple-choice questions, Written assessment with open-ended questions, Written assessment

Examination methods in case of permanent assessment

Oral assessment, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible in modified form

Extra information on the examination methods

Oral examination with written preparation.

Calculation of the examination mark

Combination of periodic evaluation (oral examination, 70% of the final score) and non-periodic evaluation (report and presentation, 30% of the final score). Participation to the non-periodic evaluation is a necessary condition to succeed for the course. Absence during the non-periodic evaluation results in a total score of maximum 9/20, independent of the score of the periodic evaluation.