Modulbezeichnung:	**Basics in Biomaterials and Bioprocessing 1+2: Biomaterials for Tissue Engineering, Biomaterial Interfaces (Bio Basics 1+2)** (Basics in Biomaterials and Bioprocessing 1+2: Biomaterials for Tissue Engineering, Biomaterial Interfaces)	**5 ECTS**
Modulverantwortliche/r:	Aldo R. Boccaccini	
Lehrende:	Sannakaisa Virtanen, Kathrin Castiglione, Aldo R. Boccaccini, Julia Will	

Startsemester: WS 2021/2022	Dauer: 2 Semester	Turnus: halbjährlich (WS+SS)
Präsenzzeit: 60 Std.	Eigenstudium: 90 Std.	Sprache: Englisch

Lehrveranstaltungen:

Basics in Biomaterials and Bioprocessing 1 (WS 2021/2022, Vorlesung, 2 SWS, Aldo R. Boccaccini et al.)
Biomaterial Interfaces (SS 2022, Vorlesung, 2 SWS, Aldo R. Boccaccini et al.)

Inhalt:

Basics in Biomaterials and Bioprocessing 1:
This course gives a general introduction to Biomaterials and Bioprocessing.
In the Biomaterials section, the processing, properties and application of the different material groups (Metals, ceramics, polymers and composite) used in medical applications are discussed. Different examples of biomaterials for orthopaedic devices are presented. Basics of materials for tissue engineering are given with emphasis on porous (scaffolds (processing, application and properties).
In the Bioprocessing part, fundamental knowledge about biological macromolecules (polysaccharides, phospholipids, proteins, DNA, RNA) and biological membranes is given. Building on this, enzyme kinetics and enzyme immobilization, growth kinetics of cells, as well as mass balances in batch, fed-batch and continuous fermentation are presented. Finally, different types of bioreactors (stirred-tank, air-lift and bubble-columns, wave-bags, roller bottles) are introduced and exemplary bioprocesses are discussed.
Basics in Biomaterials and Bioprocessing 2: Biomaterial Interfaces:
This course introduces the basics of chemistry and physics of surfaces including characterization methods for biomaterial surfaces. Surface properties which are relevant for protein and cell attachment are discussed. Fundamentals of protein and protein adsorption on biomaterials are presented as well as the effect of chemical composition, topography, hydrophobic and hydrophilic surfaces, stiffness of the biomaterial and ion release effects from the biomaterial on cell attachment and success of the implanted material in general. The lecture also gives surface modification strategies for implants and scaffolds including biomedical coatings and bioactive surfaces. The course covers also functionalization strategies for biomaterials. Protein adsorption mechanisms and the basics of the interaction between a biomaterial (implant) and tissues (foreign body reaction) are covered.

Lernziele und Kompetenzen:

Basics in Biomaterials and Bioprocessing 1:
The students
- acquire basic knowledge on the processing, microstructure and properties of a wide range of biomaterials, e.g. materials for biomedical applications
- appreciate the specific properties required for successful biomedical applications of materials and understand biocompatibility concepts
- apply their knowledge in order to select biomaterials for specific biomedical applications, e.g. bone implants, stents, wound healing materials, tissue scaffolds
- acquire fundamental knowledge about biological macromolecules, membranes and cells and are able to mathematically describe their behaviour
- can select a suitable method for the immobilization of a given protein as well as a suitable reactor and process mode for a given biotechnological process.

Biomaterial Interfaces:
The students

- acquire basic knowledge on different aspects of biomaterial interfaces, in particular about the interaction between different biomaterials (polymers, metals, ceramics and composites) with the biological environment.
- can apply their knowledge in order to judge the success of the different biomaterials

Literatur:

Basics in Biomaterials and Bioprocessing 1:

- Biomaterials Science, 2nd ed., B. D Ratner et al. (eds.), Elsevier, 2004.
- Biomaterials Fabrication and Processing, P.K.Chu, X. Liu (eds.), CRR Press, 2008
- Tissue Engineering using Ceramics and Polymers, A. R. Boccaccini, J. E. Gough (Eds.), Woodhead Publ. Ltd., 2007
- Molecular Biology of the Cell, B. Alberts et al., 6th edition, Norton & Company, 2014
- K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, VCH, 2005
- Pauline M. Doran, Bioprocess Engineering Principles, Second Edition, Academic Press, 2013

Biomaterial Interfaces:

- Biomaterials Science, 2nd ed., B. D Ratner et al. (eds.), Elsevier, 2004.
- Surface Modification of Biomaterials: Methods analysis and applications, R. Williams (ed.), Woodhead Publishing, 2010

Further recommended reading will be announced in the lectures

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Verwendbarkeit des Moduls / Einpassung in den Musterstudienplan:

Das Modul ist im Kontext der folgenden Studienfächer/Vertiefungsrichtungen verwendbar:

[1] **Advanced Materials and Processes (Master of Science)**
(Po-Vers. 2019w | TechFak | Advanced Materials and Processes (Master of Science) | Gesamtkonto | Pflichtmodule | Biomaterials and Bioprocessing)

Studien-/Prüfungsleistungen:

Biomaterials and Bioprocessing 1+2: Biomaterials for Tissue Engineering, Biomaterial Interfaces (Prüfungsnummer: 1756)
(englische Bezeichnung: Basics in Biomaterials and Bioprocessing 1+2: Biomaterials for Tissue Engineering, Biomaterial Interfaces)
Prüfungsleistung, Klausur, Dauer (in Minuten): 120
Anteil an der Berechnung der Modulnote: 100% Prüfungssprache: Englisch

Erstablegung: SS 2022, 1. Wdh.: WS 2022/2023
1. Prüfer: Aldo R. Boccaccini

Biomaterials and Bioprocessing 1: Biomaterials for Tissue Engineering (Prüfungsnummer: 1757)
Prüfungsleistung, Klausur, Dauer (in Minuten): 60
Anteil an der Berechnung der Modulnote: 50%
weitere Erläuterungen:
Gemäß Corona-Satzung wird als alternative Prüfungsform festgelegt: mündliche Prüfung mit 30 Minuten Dauer,
Prüfungssprache: Englisch

Erstablegung: WS 2021/2022, 1. Wdh.: SS 2022
1. Prüfer: Aldo R. Boccaccini

Biomaterials and Bioprocessing 2: Biomaterial Interfaces (Prüfungsnummer: 1758)
Prüfungsleistung, Klausur, Dauer (in Minuten): 60
Anteil an der Berechnung der Modulnote: 50%

Erstablegung: SS 2022, 1. Wdh.: WS 2022/2023
1. Prüfer: Aldo R. Boccaccini
