Module	**Biomaterials and Functional Surfaces**
Code	MSLS_V3_3
Degree Programme	Master of Science in Life Sciences (MSLS)
ECTS Credits	4
Workload	Total 120 h: Contact 60 h; Self-study 60 h
Module Coordinator	**Name** Prof. Dr. Jürgen Stohner **Phone** +41 (0)58 934 54 93 **Email** juergen.stohner@zhaw.ch **Address** ZHAW Zurich University of Applied Sciences Life Sciences and Facility Management Campus Reidbach PO Box CH-8820 Wädenswil
Lecturers	• Prof. Dr. Bastian Brand • Prof. Dr. Walter Krebs • Prof. Dr. Michael Raghunath
Entry Requirements	Knowledge in basic microbiology, basic cell biology, chemistry and biochemistry
Learning Outcomes and Competences	After completing the module students will: • understand the importance of surface chemistry, surface energy, surface charge and surface topography in controlling key properties such as wetting or the tendency to adsorb proteins. They are familiar with important methods of measuring surface properties and are able to design simple surface treatments in order to design surface properties according to needs in life science applications such as biochips or biomaterials. • be familiar with biomaterials and their characteristics. They understand interactions between materials and cells and therefore tissue reaction towards biomaterials. They are aware of modifications to influence these interactions. Students know current applications of biomaterials in tissue engineering, regenerative medicine, drug development and substance testing. • know the relevance and functions of biofilms in natural or artificial systems. They know key factors controlling formation, structure and dynamics of different biofilms and analytical techniques for their characterization.
Module Content	The module concerns the interaction of cells and tissues with materials and surfaces. Therefore, biological principles of cells and tissues, their extracellular matrix will and regulation mechanisms due to signalling factors will be examined. Adhesion, proliferation and differentiation as well as vascularization and biomechanical characteristics will be discussed. The role of the innate immune

	system in the tissue response towards a biomaterial will be highlighted. Characteristics of important biomaterials like metals, polymers and ceramics will be elucidated and current applications in various fields of life sciences will be considered. Important methods of cell and tissue culture technology will be introduced, including Bioprinting and chip technology. After a general overview onto nanotechnology, surface properties are discussed in detail in terms of surface and interface energies -charge and topography. The influence of size or radius of surface curvatures onto these properties is discussed. Different wetting states and their stability as a function of topography are introduced. Langmuir Blodgett films, self-assembled monolayers, plasma treatments, polymer adsorption, polymer grafting (grafting to and grafting from) are introduced as means of engineering surface properties. The influence of polymers on surfaces is discussed in terms of colloid stability and surface passivation. Debye Hückel theory is introduced and electric surface potential/zeta-potential and its consequence and control is discussed. The adsorption of proteins on surfaces is discussed in detail. The different energetic contributions to protein adsorption are discussed and surface chemistry and surface topography is correlated with protein adsorption. Techniques for suppressing non-specific protein adsorption are introduced. Smart (responsive) surfaces are introduced and potential applications are discussed. The ECM is presented as a natural example of a smart material. Nearly all natural and artificial surfaces can be colonized by microorganisms. They form biofilms, which represent very stable communities. Most of them are harmless or even beneficial, but some can also cause serious consequences, such as chronic infections. Therefore, it is important to understand the formation, structure and composition of biofilms, how to assess them, and how to modulate their formation.
Teaching / Learning Methods	• Lectures 30% • Guided exercises 25% • Practical study in groups and lab demonstrations 10% • Self-study including study of the literature 30% • Short seminars with students talks, invited guest speaker 5%
Assessment of Learning Outcome	The assessment consists of three parts: • Part 1: Written exam on biomaterials and their interaction with cells and tissues. The exam will take 2 lessons, no auxiliary means are allowed. The performance of this part will count 1/3 towards the module grade. • Part 2: Written exam on nanotechnology and functional surfaces. The exam will take 2 lessons. A personally hand-written summary of no more than 2 pages may be used during the examination. The performance of this part will count 1/3 towards the module grade. • Part 3: Oral presentation and/or written report on a selected topic related to biofilms. The performance of this part will count 1/3 towards the module grade.
Bibliography	Selected book-chapters and articles of scientific journals will be announced or provided. Important lecture notes will be distributed during the lectures.
Language	Lecture slides and notes in English, instruction in English or German
Comments	
Last Update	24.09.2021