1.	Field of study	Biophysics
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2022/2023 (winter term), 2023/2024 (winter term), 2024/2025 (winter term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Biophysical and Materials Science Characterization

Module code: W4-2BF-MB-21-14

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
MB_14_1	students will be able to understand and describe the fundamental properties of aqueous solutions and complex materials	KBF_U03 KBF_U08 KBF_W02 KBF_W07	4 4 4 4
MB_14_2	students will be able to describe the application of experimental physicochemical methods to the solid and liquid states and choose the appropriate experimental techniques that serve a specific purpose	KBF_U01 KBF_U09 KBF_W02 KBF_W10	3 3 4 4

3. Module description

Description	The course aims to provide an introduction to chemical physics, especially on liquid solutions (both electrolyte and nonelectrolyte), solid solutions, and homogeneous and hybrid materials, and on the relevant characterization techniques. Course syllabus: (1) Introduction to inorganic chemical physics of electrolyte & nonelectrolyte solutions Types of solutions. Thermodynamics of solutions. Properties of water: The hydrogen bond, solubility of molecules in water, polar and non-polar solvents. Electrical permeability of water. Dissociation: acids and bases, protonation. Properties of solutions: functional groups, hydrophilic and hydrophobic interactions; solubility; diffusion. Colligative properties: boiling-point elevation, freezing point depression, osmotic pressure. Surface tension, capillarity. Water phase diagram and anomalies; aqueous electrolytes; non-electrolyte solutions. Electrostatics of salty solutions: biopolymers (polyelectrolytes) and biomembranes in water; Poisson-Boltzmann equation, Debye-Hückel model, electric double layers, ion, and proton conduction; transport properties. (2) Introduction to materials science properties

	Cohesive interactions; structural and mechanical properties of homogeneous solids; organic molecular solids; non-miscible systems: morphology and properties of phase-separated materials (3) Laboratory techniques - Elemental analysis: photoelectron & mass spectroscopy (XPS, UPS, Auger, secondary ion mass spectroscopy) - Chemical analysis: optical and vibrational spectroscopy (UV-vis, IR, Raman), nuclear magnetic resonance (NMR) - Morphological analysis: contact angle, powder X-ray diffraction (XRD), tomography (microCT), NMR-imaging, electron microscopy (SEM, TEM, energy loss/secondary electron spectroscopy) - Phase-change analysis - Mechanical, electrical, and optical characterization - A pharmaceutical application: optical measurement of the dissolution kinetics and solubility of a drug (4) Applications to pharmaceutics, drug formulation, & biophysical pharmacology: - Experimental techniques for electrolyte and non-electrolyte solutions - Small Molecules (drugs): HPLC, Chromatography, Mass spectroscopy, ICP-MS - Characterization of Nanoparticles: Molecular sizes (Dynamics light scattering, DLS), Surface charge (zeta potential, with conductivity measures) - Characterization of Biomolecules: chromatography, gel electrophoresis, Western Blot. Proteomics
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
MB_14_w_1	credit	the basis for obtaining credit will be the grades from homework and laboratory reports	MB_14_1, MB_14_2
MB_14_w_2	exam	oral/written exam	MB_14_1, MB_14_2

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
MB_14_fs_1	lecture	Detailed discussion by the lecturer of the issues listed in the table "module description" using the table and/or multimedia presentations	30	Supplementary reading, working with the textbook, doing homework	44	MB_14_w_2
MB_14_fs_2	laboratory classes	Performance of exercises on the subject consistent with the issues listed in the table "module description"	6	Acquiring knowledge in the scope of the exercise, preparation of the final report on a given exercise	20	MB_14_w_1