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), 2025/2026 (winter term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Molecular and Soft Condensed Matter

Module code: W4-2BF-MB-21-12

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_12_1	students will be able to describe the phases of single-component molecular systems, and the main experimental techniques available to study molecular dynamics and phase transitions	KBF_W02 KBF_W07 KBF_W10	4 4 4
MB_12_2	students will be able to discuss the (dynamic) disorder present in a phase and its impact on rheological/mechanical properties and on vitrification	KBF_U01 KBF_U11 KBF_W02	4 4 4
MB_12_3	students will be able to describe the main theories that describe the properties of glasses, liquid crystals, linear polymers and polymer networks, as well as their main technological applications	KBF_U02 KBF_W02	3 4

3. Module description

Description	This unit introduces the physics of molecular and macromolecular condensed phases such as liquids, glasses, liquid crystals, plastic and orientationally disordered crystals, polymers and polymer gels. Course syllabus: (1) Basics of molecular condensed matter: introduction (polymorphism, glasses, complex fluids: mesophases & polymers); classification and mechanism of phase transitions (first order, continuous, glassy; nucleation and growth); van der Waals theory; microscopic constituents, effective interactions, disorder & dynamics; experimental tools & linear response theory; Boltzmann distribution and partition function (2) Single component systems: structural glasses, primary and secondary relaxations, aged and stable glasses; orientationally disordered solids and plastic crystals; amorphous and semicrystalline linear polymers; rotational isomeric state model; ideal chains and entanglement, normal and segmental relaxations; viscoelasticity; polymers networks, gelation and rubber elasticity; conjugated and conductive polymers; thermotropic liquid crystals and liquid

	crystal polymers) (3) Introduction to binary systems and binary equilibrium and non-equilibrium phase diagrams: heterointeractions; glass-forming mixtures; binary plastic crystals; polymer blends, solutions, and dispersions; block copolymers; polymer gels and hydrogels, swelling; superhydrophobic, superhydrophilic/ olephobic, superamphiphilic, and self-healing polymer coatings. Self-assembly in condensed matter: biopolymers, helix-coil & coil-globule transitions; surfactant-water systems, biomembranes, lyotropic liquid crystals, emulsions; semiflexible polymers & cytoskeleton; colloidal systems (glasses, crystals, nematics, gels); Applications to drug encapsulation, controlled drug release, and drug delivery.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
MB_12_w_1	exam	Oral and written presentation of case study (60%), written midterm exam (40%)	MB_12_1, MB_12_2, MB_12_3

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_12_fs_1	lecture	Detailed discussion by the lecturer of the issues listed in the table "module description" using the table and/or multimedia presentations	36	Supplementary reading, working with the textbook	64	MB_12_w_1