1.	**Nazwa kierunku**	**biofizyka**
2.	Wydział	Wydział Nauk Ścisłych i Technicznych
3.	Cykl rozpoczęcia	2021/2022 (semestr zimowy)
4.	Poziom kształcenia	studia drugiego stopnia
5.	Profil kształcenia	ogólnoakademicki
6.	Forma prowadzenia studiów	stacjonarna

Moduł kształcenia: Disordered and Off-Equilibrium Systems

Kod modułu: W4-2BF-MB-21-03

1. Liczba punktów ECTS: 6

2. Zakładane efekty uczenia się modułu

kod	opis	efekty uczenia się kierunku	stopień realizacji (skala 1-5)
MB_03_1	Students will be able to understand and analyze scientific reports concerning experimental, theoretical, and computational studies concerning the physics of disordered and off-equilibrium systems	KBF_K02 KBF_U11 KBF_W01 KBF_W03 KBF_W07 KBF_W10	4 4 4 4 4 4

3. Opis modułu

Opis	1. From order to disorder Non-periodical long-range positional order: quasi-crystals Disorder in long-range positional atomic systems (cellular disorder): Substitutional disorder: interstitial and substitutional impurities, vacancies; Orientational disorder: plastic crystals (e.g. fullerene) Disorder in atomic systems without long-range positional order (topological disorder): Base elements in real crystals: Dislocations and Burger's vector, Interfacial defects. Liquid state and amorphous state: N-bodies distribution functions, particular case: pair distribution; static structure factor; Hard sphere atomic liquids: Percus-Yevick theory. Disorder in polymeric systems: Conformations of polymeric linear chain: analogy with a random walk. Chain rigidity: Kuhn's segment. Size distribution of the linear polymeric chain. Free energy of polymeric chain, entropic elasticity. The pair distribution function of polymeric chain: self-similarity 2. From equilibrium to out of equilibrium Supercooled metastable states and glass transition in liquids: Van Hove function and its momenta; Collective and microscopic dynamics: cage effect and vibrational properties, local and structural relaxation, relaxation time distribution, diffusion, visco-elasticity; Simple models of glass transition: Free volume, Configurational entropy.

	Elements of non-equilibrium thermodynamics: Zero Principle: fictive temperature in glasses, fluctuation-dissipation theorem violation; Second Principle: Jarzynski's equality and Crooks fluctuation theorem: experimental tests in nanosystems. Polymeric chain Dynamics: Short-chain: Rouse model; Long chain: entanglement effect; Edwards tube model; De Gennes reptation motion: scale arguments. Non-equilibrium states in the active matter: Molecular Motors; Bacteria, Swimmers, swarms: emergent collective motions and glass transition. 3. Experimental techniques: structure and dynamics of disordered systems Scattering from disordered systems: generalities: Scattering cross-sections, coherent and incoherent scattering; Static and dynamic structure factor, elastic and inelastic scattering; Spatial, temporal and spatio-temporal correlation function. Photon Scattering (X-rays and light): Sources of coherent radiation (synchrotron), spectrometers and detectors; Structure of disordered systems: X-ray diffraction at a wide and small angle; Dynamics in disordered systems: Brillouin and Raman scattering, inelastic X-ray scattering, photocorrelation spectroscopy. Neutron scattering: Neutron sources and detectors: typical experimental layout; Structure of disordered systems: neutron diffraction at a wide and small angle, comparison with X-ray; inelastic neutron scattering and spectroscopy: TAS, TOF, Backscattering, Spin-Echo.
Wymagania wstępne	

4. Sposoby weryfikacji efektów uczenia się modułu

kod	nazwa (typ)	opis	efekty uczenia się modułu
MB_03_w_1	egzamin	oral exam	MB_03_1

5. Rodzaje prowadzonych zajęć

kod	rodzaj prowadzonych zajęć			praca własna studenta		sposoby weryfikacji efektów uczenia się
	nazwa	opis (z uwzględnieniem metod dydaktycznych)	liczba godzin	opis	liczba godzin	
MB_03_fs_1	wykład	Detailed discussion by the lecturer of the issues listed in the table "module description" using the table and/or multimedia presentations	48	Supplementary reading, working with the textbook	102	MB_03_w_1