Lecture title	**Liquid Crystals as functional materials in modern technologies**
Venue	Institute of Molecular Physics, Polish Academy of Sciences (IMPPAS)
Language	English
Learning objectives	Ph.D. students will learn the key concepts that enable them to understand the fundamentals of physics of phenomena occurring in liquid crystals (LC), such as: - classification and properties of mesophases, theories of the average molecular field for the LC state; - elastic, dielectric and optical properties of LC; - electrical, magnetic and acoustic properties and viscosity of LC; - light transmission through a limited anisotropic LC, ferroelectric and anti-ferroelectric LC; - selected components of display technology and electro-optical LC modulators, laser technology, holography, biosensors; -nanotechnology of LC, composites and hybrid materials.
Term/Year	summer semester 2025/2026
Lecturer's and names	dr. hab. eng. Dorota Dardas
Attendance requirements	Basic knowledge of general physics and soft matter physics
Number of ECTS points	2 ECTS
Number of lectures	6
Balance of ECTS points	Two ECTS credit corresponds to 12 lesson hours of lecture.
Didactic methods	Lectures were presented using current audio-visual techniques.
Methods of verification and assessment of learning outcomes	Written exam, individual discussion of the exam results.
Conditions of a positive evaluation	A positive score on the exam.
Course content	Basic information about liquid crystals, classification and properties of mesophases, molecular structure of mesogens, homologous series, polymorphism, chirality, order parameter, mean molecular field theory. Liquid crystal continuous medium, Zocher-Oseen-Frank NLC elasticity theory, LC elastic properties, relationships between the static electrical permittivity of nematic liquids and their molecular parameters, W. Maier and G. Meier and its extension, dielectric characteristics of LC, electromagnetic wave propagation in liquid crystal media.

	Relationships between the static electrical permeability of nematic compounds and their molecular parameters, viscosity, magnetic properties, acoustic properties, phase induction, multicomponent liquid crystal mixtures. Selected elements of the theory of light propagation in anisotropic liquid crystal media, special cases of light transmission through a birefringent system, electro-optical effects in LC, chiral and achiral liquid crystal molecules, symmetry elements, ferroelectric and antiferroelectric liquid crystal phases and their physical properties. Selected components of display technology and electro-optical LC modulators, liquid crystal measuring cells, glass substrate technology, films, laser technology, holography, biosensors. Nanotechnology of LC, nanoparticle doping, composites and hybrid materials.
Literature constituting the course materials	1) P.G. de Genes *The Physics of Liquid Crystals*, Claredon Press, Oxford (1974) 2) S.T. Lagerwall F*erroelectric and antiferroelectric liquid crystals*, Wiley-VCH, Weinheim (1999) 3) W. Haase, S. Wróbel, *Relaxation phenomena*, Berlin: Springer-Verlag (2003) 4) I. Dierking, *Textures of Liquid Crystals,* John Wiley & Sons (2003) 5) W. Kuczyński, *Chiral Liquid Crystals,* IFM PAN, Poznań (2005) 6) A. Jakli, A. Saupe, *One- and two dimensional fluids, Properties of Smectic, Lamellar and Columnar Liquid Crystals*, Taylor&Francis (2006)