Level: **bachelor**

Course title: Physics of Liquid Crystals and Applications

Status: **elective**

ECTS: 6

Requirements: none

Learning objectives

Goal of the course is understanding of specific characteristic of liquid crystalline substances (basic types: thermotropic and lyotropic, nematic, cholesteric, smectic, ferroelectric liquid crystals, basic characteristics and potential of application), as well as characterization methods used for the research in the area.

Learning outcomes

Students should have:

- General abilities of using expert literature and reference data, having knowledge of scientific and expert terminology and methods for research and characterization of liquid crystalline substances.
- Course specific abilities of having knowledge of fundamental theory of liquid crystalline substances that put it in the „soft matter“ group. Knowledge on experimental methods directed towards characterization of this specific group of materials and understanding of the most attractive area of its application in industry and display technologies

Syllabus

Theoretical instruction

Introduction. Anisotropic liquids: basic types and characteristics. Building blocks, types of organic molecules. Nematic liquid crystals: basic characteristics and build. Dynamical light scattering. Influence of electric field (twisting of nematic helical structure). Guest-host interaction. Deformation in nematic monocrystals (macroscopic deformations, free energy of deformations, comparison with magnetism, Freedericksz transition). Cholesteric liquid crystals: optical characteristics, polymorphism, shift of cholesteric pitch under the influence of: electric field, physical and chemical factor, dopants, temperature and defects. Smectic liquid crystals: fundamental smectic phases (SmA, SmB, SmC, SmD...). Biaxial and uniaxial smectic liquid crystals. Light scattering. Freedericksz transitions. Chiral smectics. Phase transitions SmC→SmA, SmA→N.

Application of nematic, cholesteric and smectic liquid crystals. Display cells. Liquid-crystalline cells as optical elements. Storage of information. Application in medicine and veterinary medicine, technology and industry. Liquid crystal displays. Lyotropic mesomorphism. Systems: lipid-water, lipid-protein. Lyotropic liquid crystals in biological systems. Polymer liquid crystals.

Practical instruction

Experimental methods for liquid crystal research: electronic and polarizing microscopy, spectroscopy (IR, UV, visible), X ray diffraction, calorimetric measurements (DSC, DTA).

Weekly teaching load				Other:
Lectures: 3	Exercises: 2	Other forms of teaching: 1	Student research:	