Course Unit Descriptor

Study Programme: Physics

Course Unit Title: Physics of Liquid Crystals and Applications

Course Unit Code: F18FTK

Name of Lecturer(s): Full Professor Maja Stojanović

Type and Level of Studies: Bachelor of Science in Physics

Course Status (compulsory/elective): Elective

Semester (winter/summer): Winter

Language of instruction: English

Mode of course unit delivery (face-to-face/distance learning): Face-to-face

Number of ECTS Allocated: 6

Prerequisites: None

Course Aims:

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:

Theory

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.

Practice

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

Required Reading:

1. G. W. Gray, P. A.Winsor: “Liquid Crystal and Plastic Crystals”, Vol.1,2, John Wiley and Sons Limited, 1974
2. P. G. De Gennes: “The Physics of Liquid Crystals”, Clarendon Press, Oxford, 1974
3. D. Demus at all: “Textures of Liquid Crystals”, VEB Deutscher Verlag für Grundstoffindustrie, Leipzig, 1978

Weekly Contact Hours:	**Lectures:** 3	**Practical work:** 2

Teaching Methods:

Theoretical classes are performed using modern methods of presentation, with the active participation of students, a practical training includes laboratory exercises and preparation and presentation of a seminar work

Knowledge Assessment (maximum of 100 points): 100

Pre-exam obligations	points	**Final exam**	points
Active class participation		written exam	30
Practical work	10	oral exam	30
Preliminary exam(s)		…….	
Seminar(s)	30		