Course Unit Descriptor

Study Programme: Physics

Course Unit Title: Nanomaterials and nanotechnology

Course Unit Code: FD18NN

Name of Lecturer(s): dr Tamara Ivetić

Type and Level of Studies: PhD Physical Sciences

Course Status (compulsory/elective): elective

Semester (winter/summer): summer

Language of instruction: English

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

Number of ECTS Allocated: 15

Prerequisites:

Course Aims:

Acquiring up-to-date theoretical and practical knowledge about nanomaterials, their properties, types, technology of obtaining and applications.

Learning Outcomes:

After completing and learning the course content, the student should have developed:
-General skills: knowledge about the basic properties, synthesis technology and the most modern application of nanomaterials, and ability to independently follow-up the professional literature in this field;
-Subject-specific skill sets: capability to independently design and carry out a synthesis experiment of a nanomaterial with the projected desired properties.

Syllabus:

Theory

Basic properties and classification of nanomaterials.
Surface and interface effects. Surface energy. Chemical potential and electrostatic stabilization.
Size effects in nanomaterials, definition, types.
Methods of obtaining nanomaterials. Methods from the gas phase-aerosol methods. Methods from the liquid phase. Sol-gel and combustion methods. Methods in the solid phase, mechanical milling, mechanochemical activation, nanopowder consolidation.
Modern methods of nanomaterials characterization. Physical properties of nanomaterials: melting points and lattice constants, mechanical and optical properties, electrical conductivity, ferroelectric and dielectric properties, superparamagnetism.
Special nanomaterials, carbon fullerenes and nanotubes, zeolites, core-shell structures, nanocomposite polymers.
Application of nanomaterials in medicine; electronics; telecommunication systems; informational, avionics and cosmic technology.
Practice

Experimental research work; and preparation and presentation of the seminary essay.

Required Reading:

1. G. Cao, *Nanostructures and Nanomaterials, Synthesis, Properties, and Applications*, Imperial College Press, London, 2004.

2. V. Pokropivny, R. Lohmus, I. Hussainova, A. Pokropivny, S. Vlassov, *Introduction to Nanomaterials and Nanotechnology*, Tartu University Press, Tartu, 2007.

4. А.И. Гусев, А.А. Рempель, *Нанокристаллические материалы*, Физматлит, Москва, 2001.

5. Z. Guo, L. Tan, *Fundamentals and Applications of Nanomaterials*, Artech House, Boston/London, 2009.

Weekly Contact Hours:	**Lectures:** 6	**Practical work:** 4

Teaching Methods:

Lectures (6 hours during the semester) are carried out using the modern presentation methods with the active participation of the student. Practical classes include experimental research work (4 hours during the semester); and the preparation and presentation of the seminar essay.

Knowledge Assessment (maximum of 100 points):

Pre-exam obligations	points	**Final exam**	points
Active class participation	5	written exam	
Practical work	10	oral exam	70
Preliminary exam(s)		…….	
Seminar(s)	15		

The methods of knowledge assessment may differ; the table presents only some of the options: written exam, oral exam, project presentation, seminars, etc.