

Level: PhD			
Course title: Nanomaterials and nanotechnology			
Status: elective			
ECTS: 15			
Requirements:			
Learning objectives 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 <i>Theoretical instruction</i> 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. <i>Practical instruction</i> Experimental research work; and preparation and presentation of the seminary essay.			
Recommended literature 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, <i>Introduction to Nanomaterials and Nanotechnology</i> , Tartu University Press, Tartu, 2007. 4. А.И. Гусев, А.А. Ремпель, <i>Нанокристаллические материалы</i> , Физматлит, Москва, 2001. 5. Z. Guo, L. Tan, <i>Fundamentals and Applications of Nanomaterials</i> , Artech House, Boston/London, 2009.			
Number of active teaching hours		Theoretical teaching: 6	Study research work: 4
Methods of teaching 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.			
Assessment of knowledge (maximum number of points 100)			
Pre-exam obligations	points	Final exam	points
Activities during lectures/consultation	5	Oral exam	70
Experimental exercises	10		
Seminar essay	15		