PhD STUDIES COURSE UNIT DESCRIPTION

Name of subject	Field of science, code	Faculty / Center	Department
Colloid Chemistry and Technology in Nanochemistry	Chemistry N 003	Chemistry and Geosciences	Physical Chemistry
Student's workload	**Credits**	**Student's workload**	**Credits**
Lectures		Consultations	
Independent study	5	Seminars	

Course annotation
The prerequisites to study the course of Colloid Chemistry and Technology in Nanochemistry are: PhD students have taken during their higher education program the following courses: physics, inorganic chemistry, physical chemistry, polymer chemistry, and colloid chemistry. The proposed course comprises the following chapters: 1. Introduction. Colloid chemistry, colloidal particle and its characteristics. Principles of classification of dispersion and colloidal systems. 2. Thermodynamic properties of the colloidal state. Melting temperature dependence on particle size. Capillary phenomena, capillary condensation. 3. Colloidal particle analysis methods. X-ray diffraction, scanning electron microscopy. 4. Principles of obtaining colloidal systems. Dispersion and its application to the mechanical synthesis of alloys and compounds. Chemical condensation methods. Preparation and application of metal hydrosols. Sol-gel technology. 5. Self-assembled colloids. Surfactants (SAM), their classification, micelle formation and thermodynamics of formation. Microcapsules and microencapsulation technologies. Solubilization and its application. Reverse micelles and their application in nanoparticle synthesis. Kinetics of reactions in micelles, classical and probabilistic approach. Nanoemulsions. 6. Formation of a double electric layer. Surface charge of nanoparticles, isoelectric point. Protein surface charge, isoelectric point. Ionic membranes and their application. 7. The role of double electrical layer structure in stability and coagulation of colloidal systems. Schulce-Hardi rule. Coagulants. DLVO theory. 8. Steric stabilization of colloidal and nanochemical systems. Flocculation. Application for the degradation of nanoparticle systems.
Reading list
1. G. Ali Mansoori. Principles of Nanotechnology. - World Scientific (2005), 360 pp. 2. Encyclopedia of Nanoscience and Nanotechnology / Ed. H.S. Nalwa, Vol. 1-10, 7 2004 3. Peter Kralchevsky, Reinhard Miller, Francesca Ravera.Colloid and Interface Chemistry for Nanotechnology. CRC press, 2019 4. Debora Berti Gerardo Palazzo. Colloidal Foundations of Nanoscience. Elsevier, 2021 5. Encyclopedia of Surface and Colloid Science, 2015, CRC Press

The names of consulting teachers	Science degree	Main scientific works published in a scientific field in last 5 year period
Henrikas Cesiulis	Prof. dr.	1. R. Levinas, N.Tsyntsaru, **H. Cesiulis**. The Characterisation of Electrodeposited MoS2 Thin Films on a Foam-Based Electrode for Hydrogen Evolution. *Catalysts*, 2020, 10 (10), art. 1182; DOI: 10.3390/catal10101182 2. M. Vainoris, **H. Cesiulis**, N. Tsyntsaru. Metal Foam Electrode as a Cathode for Copper Electrowinning. ***Coatings*** 2020, 10, 822; doi:10.3390/coatings10090822 3. E. Vernickaite, N. Tsyntsaru, K. Sobczak, **H. Cesiulis**. Electrodeposited tungsten-rich Ni-W, Co-W and Fe-W cathodes for efficient hydrogen evolution in alkaline medium. *Electrochimica Acta* 318 (2019) 597-606. https://doi.org/10.1016/j.electacta.2019.06.087

		4. R. Levinas, N.Tsyntsaru, **H. Cesiulis**. Insights into electrodeposition and catalytic activity of MoS_2 for hydrogen evolution reaction electrocatalysis, *Electrochimica Acta* 317 (2019) 427-436. **DOI:** 10.1016/j.electacta.2019.06.002 5. T. Maliar, **H. Cesiulis**, E.J. Podlaha. Coupled electrodeposition of Fe-Co-W alloys: Thin films and nanowires. *Frontiers in Chemistry* 7 (2019), Article No. 572, 11 p., **DOI:** 10.3389/fchem.2019.00542 6. E. Vernickaite, O. Bersirova, H. Cesiulis, N. Tsyntsaru. Design of Highly Active Electrodes for Hydrogen Evolution Reaction Based on Mo-Rich Alloys Electrodeposited from Ammonium Acetate Bath**.** ***Coatings.*** **2019**, *9*(2), 85; https://doi.org/10.3390/coatings9020085 . 7. **H. Cesiulis,** N. Tsytsaru, E. J. Podlaha, D. Li, J. Sort. Electrodeposition of Iron-Group Alloys into Nanostructured Oxide Membranes: Synthetic Challenges and Properties*.* *Current Nanoscience*, 2019, 15, 84-99.

Certified during Doctoral Committee session on September 28th, 2021. Protocol No. 610000-KT-142.
Committee Chairman prof. habil. dr. Aivaras Kareiva