

## PHD STUDIES COURSE UNIT DESCRIPTION

Name of subject	Field of science, code	Faculty / Center	Department
<b>Macromolecular structure and methods of investigation</b>	Chemistry N 003	Chemistry and Geosciences	Polymer Chemistry
Student's workload	Credits	Student's workload	Credits
Lectures		Consultations	2
Independent study	7	Seminars	

### Course annotation

Chain structure and configuration. Steric, geometric and substitutional isomerism. Tacticity in polymers, stereoisomerism. Polymer chain conformations, bond rotation and polymer size. Kuhn segment. Chain models. The random coil. Spheres, rods and coils. Chain stiffness. Radius of gyration. Polymer chain conformations in solutions and in solid state.

Types of copolymers. Distribution of monomeric units in copolymer chains. Size and shape of block- and graft copolymers in solutions.

Supramolecular structure of polymers. Crystalline and amorphous regions. First-order and second-order transitions. Glass transition. Melting phenomena. Crystal structure, crystallinity. Crystallization from the melt. Spherulitic morphology. Kinetics of crystallization. Supramolecular structure of natural polymers, block- and graft copolymers. Oriented polymers.

Experimental determination of polymer size and structure. Number-average and weight-average molecular weight. Dispersity of polymers. Determination of polymer molecular weights. Membrane osmometry, size exclusion chromatography, MALDI-TOF-MS. Static and dynamic light scattering in polymer solutions. Study of polymers by NMR, FTIR and Raman spectroscopy. Study of polymers by X-ray diffraction, TEM, SEM and AFM.

### Reading list

1. S. Koltzenburg, M. Maskos, O. Nuyken. *Polymer Chemistry*. Springer, 2017.
2. P.C. Hiemenz, T.P. Lodge. *Polymer Chemistry*. 2nd ed. CRS Press, 2007.
3. L.H. Sperling. *Introduction to Physical Polymer Science*. 4th ed. John Wiley & Sons, 2006.
4. R. Yang. *Analytical methods for polymer characterization*. CRC Press, 2018.
5. C.R. Crompton. *Characterization of Polymers*. Vol. 1 & 2. ChemTec Publishing, 2009.

The names of consulting teachers	Science degree	Main scientific works published in a scientific field in last 5 year period
Ričardas Makuška	Dr. (HP), prof.	<ol style="list-style-type: none"> <li>1. J. Jonikaite-Svegziene, A. Kudresova, S. Paukstis, M. Skapas, R. Makuska. <i>Polym. Chem.</i>, 2017, <b>8</b>, 5621–5632.</li> <li>2. P. Radzevicius, M. Steponaviciute, T. Krivorotova, R. Makuska. <i>Polym. Chem.</i>, 2017, <b>8</b>, 7217-7228.</li> <li>3. I. Dobryden M. Steponaviciute, V. Klimkevicius, R. Makuska, A. Dedinaite, X. Liu, R.W. Corkery, P.M. Claesson. <i>Langmuir</i>, 2019, <b>35</b>, 15515-15525.</li> <li>4. V. Klimkevicius, M. Steponaviciute, R. Makuska <i>Eur. Polym. J.</i>, 2020, <b>122</b>, 109356.</li> <li>5. M. Steponavičiūtė, V. Klimkevičius, R. Makuška. <i>Macromol. Chem. Phys.</i>, 2021, <b>222</b>, 2000364.</li> </ol>

Certified during Doctoral Committee session on September 28<sup>th</sup>, 2021. Protocol No. 610000-KT-142.

Committee Chairman prof. habil. dr. Aivaras Kareiva