

PHD STUDIES COURSE UNIT DESCRIPTION

Name of subject	Field of science, code	Faculty / Center	Department
Heterochain Polymers	Chemistry N 003	Faculty of Chemistry and Geosciences	Polymer Chemistry Dept.
Student's workload	Credits	Student's workload	Credits
Lectures		Consultations	
Independent study	5	Seminars	

Course annotation

In this course we deal with heterochain polymers – their synthesis, structure-properties relations, and their application trends. A peculiar attention will be paid to a large-scale industrially produced heterochain polymers and to those who have particular interest in a present-day engineering and technology.

1. IUPAC nomenclature of carbochain, organic and inorganic heterochain, and coordination polymers. Carbon bonds with common elements. Relation of bond stability to a thermal and chemical stability of heterochain polymer. Classification of heterochain polymers and their synthesis pathways: polycondensation, polyaddition, cationic and anionic polymerization.

2. Polycondensation. 2a. Equilibrium polycondensation. Equilibrium polycondensation mechanism, technique, kinetics, reaction rate and molecular weight distribution. Probability of cyclization. Linear saturated polyesters. Polyethylene terephthalate. Unsaturated oligoesters and oligoester acrylates: synthesis, uses and crosslinking. Branched polyesters and alkyd resins. Alkyd resins synthesis pathways and monomers used thereto. Crosslinking mechanisms of alkyd resins. Siccatives. Modified alkyd resins. Water-soluble alkyd resins and their crosslinking. Aliphatic polyamides: synthesis from monomers and monomer salts. Polyanhydrides. Synthesis of epoxy resins (polyethers) from bisphenol A and their application. Urea- and melamine- formaldehyde resins. 2b. Non-equilibrium (interfacial) polycondensation: peculiarities, kinetics and technique. Polysulfides (Thiokl rubbers). Polyarylates. Polycarbonates. Synthesis of polyamides from diamines and dicarboxylic acid halides (aramids). Ionenes: synthesis, properties and application trends. 2c. Two-stage polycondensation. Cyclic polyimides. Polybenzimidazoles. 2d. Hydrolytic polycondensation. Polysiloxanes. Polycaprolactam.

3. Polyaddition. Polyurethanes and their foams. Crosslinking of epoxy resins.

4. Cationic ring-opening polymerization. Polyethyleneimine.

5. Anionic ring-opening polymerization. Polyethylene glycols. Polycaprolactone. Polyformaldehyde (polyoxymethylene) and its copolymers.

Reading list

1. Synthetic Methods in Step-Growth Polymers. Ed. by Martin E. Rogers and Timothy Long. 2003, John Wiley & Sons, Inc.
2. Malcolm P. Stevens. Polymer Chemistry. 3d ed., 1999, New York: Oxford University Press.
3. Žemaitaitis A. Polimerų fizika ir chemija (in Lithuanian). 2001, Kaunas: Technologija.
4. Odian G. Principles of Polymerization. 4th ed, 2004, New Jersey: John Wiley & Sons, Inc.
5. Handbook of Ring-Opening Polymerization. Ed. by Philippe Dubois, Olivier Coulembier, and Jean-Marie Raquez. 2009, Wiley-Vch Verlag GmbH & Co. KGaA.

The names of consulting teachers	Science degree	Main scientific works published in a scientific field in last 5 year period
Aušvydas Vareikis	Dr.	<ol style="list-style-type: none"> 1) Bockuviene A., Balciunaite J., Slavuckyte K., Zaliauskiene L., Vareikis A., Makuska R. Poly(ethylene glycol) modified poly(2-hydroxypropylene imine) as efficient reagent for siRNA transfection. <i>J. Polym. Res.</i> 23 (1), (2016), DOI: 10.1007/s10965-015-0898-9. 2) Bockuviene A., Slavuckyte K., Vareikis A., Zigmantas S., Zaliauskiene L., Makuska R.

		<p>Intracellular Delivery and Triggered Release of DNA Using Biodegradable Poly(2-hydroxypropylene imine)s Containing Cystamine Units. <i>Macromolecular bioscience</i>, 16 (10), (2016), 1497-1505. DOI: 10.1002/mabi.201600155.</p> <p>3) Zigmantas S., Zaliauskiene L., Makuska R., Bockuviene A., Vareikis A. Biodegradable cationic polymers and uses thereof. WO2017156447 (A1) – 2017-09-14.</p> <p>4) Kirsnyte M., Jurkunas M., Kancleris Z, <i>et al.</i> Investigation of in situ formed conductive polymer composite in adhesive matrix. <i>Synthetic Metals</i>, 258 (2019), 116181. DOI: 10.1016/j.synthmet.2019.116181.</p>
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<p>Certified during Doctoral Committee session on September 28th, 2021. Protocol No. 610000-KT-142. Committee Chairman prof. habil. dr. Aivaras Kareiva</p>
