

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	POLIMERNO REAKCIJSKO INŽENIRSTVO
Course Title:	POLYMER REACTION ENGINEERING

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Kemijsko inženirstvo, 2. stopnja	/	1.	2.
USP Chemical Engineering, 2 nd Cycle	/	1 st	2 nd

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: IN2106

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	30	15 LV	/	/	75	5

Nosilec predmeta / Lecturer: prof. dr. Urška Šebenik / Dr. Urška Šebenik, Full Professor

Jeziki / Languages:

Predavanja / Lectures:	slovenski / Slovenian
Vaje / Tutorial:	slovenski / Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	Prerequisites: The course has to be assigned to the student.
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Vsebina:

- Mehanizmi polimerizacij, vplivi reakcijskega medija
- Homogena radikalna polimerizacija: kinetika radikalne polimerizacije, difuzijsko kontrolirane reakcije, vrste polimerizacijskih reaktorjev, kinetično modeliranje, modeliranje porazdelitev molekulskih mas, načrtovanje reaktorjev;
- Heterogene polimerizacije: suspenzijska in emulzijska polimerizacija, kinetika heterogenih polimerizacijskih procesov, transportni pojavi, vrste reaktorjev, načrtovanje procesnih naprav;
 - Povečevanje polimerizacijskih procesov;
 - Seminar in laboratorijske vaje: Obravnava izbranih integralnih polimerizacijskih procesov.

Content (Syllabus outline):

- Polymerization mechanisms, effects of reaction medium
- Homogeneous free-radical polymerization: polymerization kinetics, diffusion controlled reactions, types of polymerization reactors, kinetics modelling, molecular weight distribution modelling, reactor and equipment design;
- Heterogeneous polymerizations: suspension polymerization, emulsion polymerization, kinetics of heterogeneous polymerization processes, transport phenomena, types of reactors, reactor and equipment design;
 - Scale-up for polymerization processes;
 - Seminar and laboratory practice: Selected

case studies of integrated polymerization processes.

Temeljna literatura in viri / Readings:

- Rudin, The Elements of Polymer Science and Engineering, 2nd Edition, Academic Press, London, 1999, 483 pages, (50 %).
- J. M. Asua, Polymer reaction engineering, Blackwell Publishing LTD, Oxford, 356 str. (40 %).
- N. A. Dotson, R. Galvan, R. L. Laurence, M. Tirrell, Polymerization Process Modelling, VCH, New York, 1996, 359 pages, (20 %).

Dopolnilna literatura:

- R. G. Gilbert, Emulsion Polymerization: A Mechanistic Approach, Academic Press, London, 1995, 341 pages.
- T. Meyer in J. Keurentjes, Handbook of Polymer Reaction Engineering, Wiley-VCH, Weinheim, 2005, 1083 pages.

Cilji in kompetence:

Cilj predmeta je, da študentje osvojijo pomen in vlogo reakcijskega inženirstva na področju polimerizacijskih procesov.

Študentje pri predmetu pridobijo naslednje specifične kompetence:

- poznavanje reakcijske kinetike polikondenzacij in vpliva procesnih pogojev na kinetiko;
- poznavanje reakcijske kinetike radikalske polimerizacije in vpliva procesnih pogojev na kinetiko;
- poznavanje reakcijske kinetike polimerizacijskih procesov v heterogenih sistemih;
- razumevanje vpliva transporta gibalne količine, snovi in toplote na sintezo polimerov;
- razumevanje modeliranja polimerizacijskih shem;
- poznavanje kinetičnega modeliranja polimerizacijskih procesov;
- razumevanje uporabe matematičnih modelov za načrtovanje procesnih naprav;
- razumevanje povečevalnih kriterijev, specifičnih za posamezne polimerizacijske procese.

Objectives and Competences:

Understanding the importance and role of reaction engineering in polymerization processes;

Acquisition of knowledge about step-growth polymerization kinetics and about the effect of process parameters on kinetics; Acquisition of knowledge about chain-growth polymerization kinetics and about the effect of process parameters on kinetics; Acquisition of knowledge about kinetics in heterogeneous polymerization systems; Understanding of effects of momentum, mass and heat transport on polymer synthesis; Understanding the principles of polymerization scheme modelling; Ability to model the kinetics of polymerization processes; Understanding the implementation of mathematical models in reactor and process equipment design; Understanding the scale-up criteria for specific polymerization processes.

Predvideni študijski rezultati:

Intended Learning Outcomes:

<u>Znanje in razumevanje</u> Študent zna samostojno analizirati polimerizacijski proces in ga kvantitativno zapisati. Zapisane modele zna uporabiti za analizo, načrtovanje in optimizacijo različnih polimerizacijskih procesov.	<u>Knowledge and Comprehension</u> Ability of independent polymerization process analysing and quantitative describing; Ability of employing theoretical mathematical models for analysis, design and optimization of polymerization processes.
<u>Uporaba</u> Pridobljena znanja je sposoben uporabiti pri samostojnem razvojnem in raziskovalnem delu na področjih analize, načrtovanja in optimizacije procesov.	<u>Application</u> Acquired knowledge is necessary for independent research and development in the area of process analysis, design and optimization.
<u>Refleksija</u> Študent je sposoben samostojno sklepati, definirati problem, postavljati zaključke in probleme reševati. Znanje polimernega reakcijskega inženirstva mu omogoča aktivno sodelovanje in komunikacijo s strokovnjaki drugih tehniških in naravoslovnih ved.	<u>Analysis</u> Development of abilities of autonomous deducting, problem defining, problem solving, and coming to conclusions; Ability to communicate and cooperate with experts from familiar and other engineering and natural sciences.
<u>Prenosljive spretnosti</u> Zna identificirati in reševati probleme, sposoben je zbiranja in interpretacije podatkov, kritične analize in sinteze pridobljenih znanj.	<u>Skill-transference Ability</u> Ability to identify and solve problems, to collect and interpret data, to analyse results critically and to synthesize knowledge.

Metode poučevanja in učenja:

Predavanja, seminarji, vaje.

Learning and Teaching Methods:

Lectures, seminars, laboratory practice.

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

Pisni izpit. Opravljene vaje in seminarska naloga so pogoj za pristop k izpitu.		Written exam. Laboratory practice and project work are prerequisites to exam attendance.
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Reference nosilca / Lecturer's references:

- RUČIGAJ, Aleš, ALIČ, Branko, KRAJNC, Matjaž, **ŠEBENIK, Urška**. Investigation of cure kinetics in a system with reactant evaporation : epoxidized soybean oil and maleic anhydride case study. *European Polymer Journal*, ISSN 0014-3057. [Print ed.], 2014, vol. 52, no. 1, str. 105-116. [COBISS.SI-ID [1667887](#)]
- MOHORIČ, Ines, **ŠEBENIK, Urška**. Semibatch anionic ring-opening polymerization of octamethylcyclotetrasiloxane in emulsions : effect of the amount of seed polymer particles. *Polymer international*, ISSN 0959-8103, 2013, vol. 62, no. 7, str. 1022-1028. [COBISS.SI-ID [36249093](#)]
- **ŠEBENIK, Urška**, KRAJNC, Matjaž. Seeded semibatch emulsion copolymerization of methyl methacrylate and butyl acrylate using polyurethane dispersion : effect of soft segment length on kinetics. *Colloids and surfaces. A, Physicochemical and Engineering Aspects*, ISSN 0927-7757. [Print ed.], 2004, vol. 233, no. 1/3, str. 51-62. [COBISS.SI-ID [25609989](#)]

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