

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

|                      |                                                                      |
|----------------------|----------------------------------------------------------------------|
| <b>Predmet:</b>      | <b>POLIMERNI MATERIALI IZ OBNOVLJIVIH SUROVIN IN TEHNOLOGIJE</b>     |
| <b>Course title:</b> | <b>POLYMERIC MATERIALS FROM RENEWABLE RESOURCES AND TECHNOLOGIES</b> |

| <b>Študijski program in stopnja</b><br><b>Study programme and level</b> | <b>Študijska smer</b><br><b>Study field</b> | <b>Letnik</b><br><b>Academic year</b> | <b>Semester</b><br><b>Semester</b> |
|-------------------------------------------------------------------------|---------------------------------------------|---------------------------------------|------------------------------------|
| Tehnologija polimerov, 1. stopnja                                       |                                             | 3.                                    | 2.                                 |
| Polymer Technology, 1 <sup>st</sup> level                               |                                             | 3 <sup>rd</sup>                       | 2 <sup>nd</sup>                    |

**Vrsta predmeta / Course type**

Izbirni / Chosen

**Univerzitetna koda predmeta / University course code:**

PMOST

| <b>Predavanja</b><br><b>Lectures</b> | <b>Seminar</b><br><b>Seminar</b> | <b>Vaje</b><br><b>Tutorial</b> | <b>Klinične vaje</b><br><b>work</b> | <b>Druge oblike</b><br><b>študija</b> | <b>Samost. delo</b><br><b>Individ.</b><br><b>work</b> | <b>ECTS</b> |
|--------------------------------------|----------------------------------|--------------------------------|-------------------------------------|---------------------------------------|-------------------------------------------------------|-------------|
| 25                                   |                                  | 10 SV, 15 LV                   |                                     |                                       | 100                                                   | 5           |

**Nosilec predmeta / Lecturer:**

izr. prof. dr. Irena Pulko/ Assoc. Prof. Dr. Irena Pulko

**Jeziki /****Predavanja / Lectures:**

Slovenski / Slovenian

**Languages:****Vaje / Tutorial:**

Slovenski / Slovenian

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

Osnovna znanja o splošni kemiji, uvod v polimere, kemiji polimerov, polimernem inženirstvu in strokovnem tujem jeziku.

**Prerequisites:**

Basic knowledge of general chemistry, introduction to polymers, polymer chemistry, polymer engineering as well as professional foreign language.

**Vsebina:**

Alternativne surovine in tehnologije za proizvodnjo polimernih materialov: petrokemična proizvodnja; karbokemična proizvodnja; biotehnološka proizvodnja.

Obnovljive surovine kot viri za proizvodnjo polimernih materialov: opredelitev pojma obnovljive surovine oz. viri; vloga in pomen obnovljivih surovin; razvrščanje obnovljivih surovin za proizvodnjo polimernih materialov; rastlinski viri: živalski viri; bakterijski polimeri.

Opredelitev, razvrščanje, razvoj in tržni vidiki biopolimerov: opredelitev in razvrščanje biopolimerov; razvoj biopolimerov; tržni vidiki biopolimerov.

Pregled izbranih polimernih materialov iz obnovljivih surovin in tehnologij: celuloza; hemiceluloze; lignini; tanini; kemična modifikacija in utekočinjanje lesa; naravni kavčuk; škrob; polimerni materiali iz rastlinskih olj; alginati; proteini; hitin in hitozan; polimlečna kislina; poli(hidroksialkanoati); bakterijska celuloza; biopoliolefini.

**Content (Syllabus outline):**

Alternative raw materials and technologies for production of polymer materials: petrochemical production; coal chemical production; biotechnological production.

Renewable resources as sources for production of polymer materials: definition of the term renewable resources; role and importance of renewable resources; classification of renewable resources for production of polymer materials; vegetable resources; animal resources; bacterial polymers.

Definition, classification, development and market aspects of biopolymers: definition and classification of biopolymers; development of biopolymers; market aspects of biopolymers.

Overview of selected polymer materials based on renewable resources and technologies: cellulose; hemicelluloses; lignins; tannins; chemical modification and liquefaction of wood; natural rubber; starch; polymer materials from vegetable oils; alginates; proteins; chitin and chitosan; polylactid acid; poly(hidroksialkanoates); bacterial cellulose; biopolyolefines.

**Temeljni literatura in viri / Readings:**

1. Musil V., Švab I., Polimerni materiali iz obnovljivih surovin in tehnologije – zbrano gradivo. Visoka šola za tehnologijo polimerov, Slovenj Gradec, 2016.
2. Belgacem N. M., Gandini A., Monomers, Polymers and Composites from Renewable Resources. Elsevier, Amsterdam, 2008.
3. Endres H. J., Siebert Raths A., Engineering Biopolymers. Hanser, Muenchen, 2010.
4. Pilla S. (ur.): Handbook of Bioplastics and Biocomposites Engineering Applications. Wiley, Hoboken, 2011.
5. Musil V., Importance of Biorefineries for the Development of Industrial Products. Visoka šola za tehnologijo polimerov, Slovenj Gradec, 2015, 41 PP.

**Cilji in kompetence:**

Predmetno specifični cilji in kompetence:

- Cilj predmeta je, da študent spozna polimerne materiale iz obnovljivih surovin in nove tehnologije za njihovo proizvodnjo. Seznani se s prednostmi in možnostmi uporabe alternativnih gradiv za različne tehnične namene.

**Predvideni študijski rezultati:**

Znanje in razumevanje:

- Študent pozna in razume obravnavane vsebine predmeta in jih zna uporabiti pri reševanju praktičnih problemov v proizvodnji in predelavi polimernih materialov.

**Objectives and competences:**

Course specific goals and competences:

- The aim the course is that students learn the polymer materials from renewable resources and new technologies for their production. They learn the benefits and opportunities to use alternative materials for various technical purposes.

**Intended learning outcomes:**

Knowledge and understanding:

- The student knows and understands the subject matter dealt with and can use them in solving practical problems in the production and processing of polymer materials.

**Metode poučevanja in učenja:**

- klasična predavanja
- AV predstavitev
- obravnava študijskih primerov
- aktivno skupinsko delo
- delo v laboratoriju

**Learning and teaching methods:**

- lectures
- AV presentations
- case studies
- active teamwork
- laboratory work

**Pogoj za pristop k izpitu:**

- 100 % prisotnost na laboratorijskih in seminarskih vajah
- priznana laboratorijska poročila
- priznana seminarska naloga

**The condition for admission to exam:**

- 100 % attendance on laboratory and seminar tutorials
- approved laboratory reports
- approved seminar paper

Delež (v %) /

Weight (in %)

**Načini ocenjevanja:****Assessment:**

|                                                       |    |                                                          |
|-------------------------------------------------------|----|----------------------------------------------------------|
| - interaktivno delo na predavanjih                    | 10 | - interactive work at lectures                           |
| - laboratorijske vaje                                 | 20 | - laboratory tutorials                                   |
| - izdelava, predstavitev in zagovor seminarske naloge | 20 | - preparation, presentation and defence of seminar paper |
| - Pisni in/ali ustni izpit                            | 50 | - Written in/and oral exam                               |

## Reference nosilca / Lecturer's references:

### izr. prof. dr. Irena Pulko

#### (1) Pedagoško delo:

- nosilka in izvajalka predmetov na dodiplomskem in podiplomskem študiju na FTPO
- predavanje na tuji univerzi v okviru Erasmus mobilnosti

#### (2) Raziskovalno delo:

- vodja ali izvajalka projektov in programov financiranih s strani ministrstva, Agencije za raziskovalno in razvojno dejavnost ter Evropske unije

#### (3) Pomembnejša dela:

- PULKO, Irena, WALL, Jennifer, KRAJNC, Peter, CAMERON, Neil R. Ultra-high surface area functional porous polymers by emulsion templating and hypercrosslinking : efficient nucleophilic catalyst supports. Chemistry (Weinh., Print). [Print ed.], Feb. 2010, vol. 16, iss. 8, str. 2350-2354.
- JEŘÁBEK, Karel, PULKO, Irena, SOUKUPOVA, Krasimira, ŠTEFANEC, Dejan, KRAJNC, Peter. Porogenic solvents influence on morphology of 4-vinylbenzyl chloride based polyHIPEs. Macromolecules, 2008, vol. 41, iss. 10, str. 3543-3546.
- PULKO, Irena, KRAJNC, Peter. High internal phase emulsion templating - a path to hierarchically porous functional polymers. Macromolecular rapid communications, 2012, vol. 33, iss. 20, str. 1731-1746.
- HUSKIĆ, Miroslav, PULKO, Irena. The synthesis and characterization of multiarm star-shaped graft copolymers of polycaprolactone and hyperbranched polyester. European Polymer Journal, 2015, vol. 70, str. 384-391.

## Lecturer's references:

### Assoc. Prof. Dr. Irena Pulko

#### (1) Teaching:

- lecturer of subjects at undergraduate and postgraduate level at FTPO
- teaching at foreign university (Erasmus mobility)

#### (2) Research:

- leader and researcher on the projects and programs financed by the ministry, Slovenian Research Agency and the European Commission

#### (3) Selected publications:

- PULKO, Irena, WALL, Jennifer, KRAJNC, Peter, CAMERON, Neil R. Ultra-high surface area functional porous polymers by emulsion templating and hypercrosslinking : efficient nucleophilic catalyst supports. Chemistry (Weinh., Print). [Print ed.], Feb. 2010, vol. 16, iss. 8, str. 2350-2354.

- JEŘÁBEK, Karel, PULKO, Irena, SOUKUPOVA, Krasimira, ŠTEFANEC, Dejan, KRAJNC, Peter. Porogenic solvents influence on morphology of 4-vinylbenzyl chloride based polyHIPEs. *Macromolecules*, 2008, vol. 41, iss. 10, str. 3543-3546.
- PULKO, Irena, KRAJNC, Peter. High internal phase emulsion templating - a path to hierarchically porous functional polymers. *Macromolecular rapid communications*, 2012, vol. 33, iss. 20, str. 1731-1746.
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