UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Biosenzorske tehnike na osnovi neravnovesnih plazemskih tehnologij
Course title:	Plasma-Assisted Bio-Sensing Techniques

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Senzorske tehnologije, 3. stopnja	/	1	1
Sensor technologies, 3rd cycle	/	1	1

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: ST3-543

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
15	15			15	105	**5**

**Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transfered to individual work.*

Nosilec predmeta / Lecturer: Prof. dr. Miran Mozetič

Jeziki / Languages:	
Predavanja / Lectures:	Slovenski ali angleški / Slovene or English
Vaje / Tutorial:	Slovenski ali angleški / Slovene or English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Zaključen študij druge stopnje ustrezne (naravoslovne ali tehniške) smeri ali zaključen študij drugih smeri z dokazanim poznavanjem osnov področja predmeta (pisna dokazila, pogovor).	Completed second cycle studies in natural sciences or engineering or completed second cycle studies in other fields with proven knowledge of fundamentals in the field of this course (certificates, interview).

Vsebina:	**Content (Syllabus outline):**
• Sodobni mikro- in nano- strukturirani senzorji, primerni za detekcijo krvnih proteinov, trombocitov, virusov in virusom podobnih makromolekul. • Omejitve obstoječih senzorjev in trendi v razvoju novih senzorjev. • Uporaba kremenove mikrotehtnice za detekcijo tankih bioloških filmov. • Spektroskopija fragmentov biomolekul za detekcijo mikroelementov in specifičnih funkcionalnih skupin. • Uporaba neravnovesnih plinov za modifikacijo površinskih lastnosti bio-polimerov in specifično konformacijo makromolekul.	• Advanced micro- and nano- structured sensors suitable for detection of blood proteins, platelets as well as viruses and virus-like macromolecules. • Limitations of existing sensors and current trends in development of novel sensors. • Application of quartz microbalance technique for probing adhesion of thin biological films. • Spectrometry of biomolecular fragments for detection of microelements as well as specific functional groups. • Application of non-equilibrium gases for modification of biopolymers to allow specific adsorption and conformation of macromolecules.

Temeljni literatura in viri / Readings:

Knjige / Books:

- Dawn Nafus, Quantified Biosensing Technologies in Everyday Life, The MIT Press, Boston, 2016, ISNB 9780262528757.
- Sarah Fearn, An Introduction to Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS) and its Application to Materials Science, Morgan & Claypool Publishers, San Rafael (California), 2015, ISBN: 978-1-6817-4024-9.

Revije / Journals:

- Colloids and Surfaces B: Biointerfaces.
- Journal of Biomedical Materials Research Part A.
- Macromolecular Bioscience.
- Sensors.

Cilji in kompetence:

- Vrednotenje plazemskih tehnologij za modifikacijo površin biosenzorjev,
- analiza signala kremenove mikrotehtnice,
- vrednotenje mehanizmov adsorpcije biomaterialov,
- analiza spektrov molekularnih fragmentov in vrednotenje mikroelementov ter specifičnih funkcionalnih skupin,
- sinteza biopolimerov z uporabo nevtralnih plinskih radikalov.

Kompetence:

- izbira optimalnih senzorjev za detekcijo makromolekul, proteinov, krvnih trombocitov ali mikroveziklov in presoja uporabnosti za reševanje specifičnih znanstvenih ali tehnoloških problemov,
- prepoznavanje in presoja kinetike adhezije in značilnosti adsorbiranih plasti,
- pojasniti obnašanje proteinov, krvnih trombocitov in makromolekul med interakcijo z izbranimi trdnimi snovmi.

Objectives and competences:

- Evaluation of plasma technologies for surface modification of biosensors,
- Analysis of quartz crystal microbalance signal.,
- Evaluation of adsorption mechanisms for biomaterials,
- Analysation of fragmentized macromolecules spectra and evaluation of microelements and specific functional groups,
- Synthesis of biopolymers with reactive neutral gaseous radicals.

Competences:

- selecting optimal sensors for specific macromolecules, proteins, blood platelets and microvesicles and ability to solve specific scientific and/or technological problems,
- Identification and evaluation of adhesion kinetics and properties of adsorbed films,
- Prediction and explanation of proteins, blood platelets and macromolecules behaviour upon interaction with selected solid materials.

Predvideni študijski rezultati:

Znanje in razumevanje:

- obvladovanje plazemskih tehnik za načrtovanje površin biosenzorjev ter vloge mikro- in nano-strukturiranosti površin v biosenzoriki,
- sposobnost uporabe naprednih metod za merjenje adsorbcije in določanje sestave in strukture biomaterialov iz analize fragmentov,
- kritična ocena prednosti in pomanjkljivosti novih metod bio-senzorike in njihova uporaba pri raziskovalno-razvojnem delu,

Intended learning outcomes:

Knowledge and understanding:

- selection of plasma-based techniques for tailoring biosensor surfaces and role of micro- and nano-structured surfaces,
- application of advanced techniques for determination of adsorption kinetics and composition as well as structure of biomaterials using fragment analyses,
- critical estimation of advantages and drawbacks of novel bio-sensing methods and their

• sinteza inovativnih biosenzorjev in presoja njihovih funkcionalnosti, • prepoznavanje tehnoloških problemov in internacionalizacija inovativnih rešitev.	implementation in research and development, • synthesis of innovative biosensors and evaluation of their functionalities, • recognition of technological problems and internationalization of innovative solutions.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Interaktivno delo s študenti. Predstavitev vsebine predmeta v obliki kratkih predavanj. Uporaba biosenzorjev pri reševanje konkretnih problemov, s katerimi se srečuje posamezen študent.	Interactive work with students. Introduction to the subject in the form of short courses. Application of biosensors for solving specific problems related to research of a particular student.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Ustna predstavitev tematike raziskav posameznega študenta	20 %	Oral presentation of a student's research task.
Seminarska naloga	40 %	Seminar
Usten zagovor seminarske naloge	40 %	Oral justification of the seminar

Reference nosilca / Lecturer's references:

- KULKARNI, Mukta Vishwanath, MAZARE, Anca, GONGADZE, Ekaterina, PERUTKOVÁ, Šárka, KRALJ-IGLIČ, Veronika, MILOŠEV, Ingrid, SCHMUKI, Patrik, IGLIČ, Aleš, MOZETIČ, Miran. Titanium nanostructures for biomedical applications. Nanotechnology, ISSN 0957-4484, 2015, vol. 26, no. 6, str. 062002-1-062002-19, doi: 10.1088/0957-4484/26/6/062002.
- OZALTIN, Kadir, LEHOCKÝ, Marián, HUMPOLÍČEK, Petr, VESELA, Daniela, MOZETIČ, Miran, NOVAK, Igor, SÁHA, Petr. Preparation of active antibacterial biomaterials based on sparfloxacin, enrofloxacin, and lomefloxacin deposited on polyethylene. Journal of applied polymer science, ISSN 1097-4628. [Online ed.], 2018, vol. 135, no. 15, str. 46174-1-46174-7, doi: 10.1002/app.46174
- VUKUSIĆ, Tomislava, VESEL, Alenka, HOLC, Matej, ŠČETAR, Mario, REŽEK JAMBRAK, Anet, MOZETIČ, Miran. Modification of physico-chemical properties of acryl-coated polypropylene foils for food packaging by reactive particles from oxygen plasma. Materials, ISSN 1996-1944, 2018, vol. 11, no. 3, str. 372-1-372-17, doi: 10.3390/ma11030372.
- GORJANC, Marija, MOZETIČ, Miran, PRIMC, Gregor, VESEL, Alenka, SPASIĆ, Kosta, PUAČ, Nevena, PETROVIĆ, Zoran Lj., KERT, Mateja. Plasma treated polyethylene terephthalate for increased embedment of UV-responsive microcapsules. Applied Surface Science, ISSN 0169-4332. [Print ed.], 15. Oct. 2017, vol. 49, str. 224-234, ilustr. http://www.sciencedirect.com/science/article/pii/S0169433217312126, doi: 10.1016/j.apsusc.2017.04.17.
- KAŠPÁRKOVÁ, Věra, HUMPOLÍČEK, Petr, CAPÁKOVÁ, Zdenka, BOBER, Patrycja, STEJSKAL, Jakub, TRCHOVÁ, Miroslava, REJMONTOVÁ, Petra, JUNKAR, Ita, LEHOCKÝ, Marián, MOZETIČ, Miran. Cell-compatible conducting polyaniline films prepared in colloidal dispersion mode. Colloids and surfaces. B, Biointerfaces, ISSN 0927-7765. [Print ed.], 2017, vol. 157, str. 306-316, doi: 10.1016/j.colsurfb.2017.05.066.