

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Nanovarnost
Course title:	Nanosafety

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Nanoznanosti in nanotehnologije, 3. stopnja	/	1	1
Nanosciences and Nanotechnologies, 3 rd cycle	/	1	1

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: NANO3-817

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 transferred to individual work.*

Nosilec predmeta / Lecturer: Prof. dr. Maja Remškar

Jeziki / Predavanja / Lectures: Slovenščina, angleščina / Slovenian, English
Languages: Vaje / Tutorial:

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

Zaključena izobrazba druge stopnje ali univerzitetna izobrazba s področja naravoslovja ali tehnologije.

Prerequisites:

Completed second level education or university education from natural sciences or technology.

Vsebina:

Z razvojem nanotehnologije na osnovi posebnih lastnosti nanodelcev, kot so velika mobilnost, povečana kemična aktivnost in razmerje med površino in prostornino, majhna velikost, majhna masa in spremenjene kemijske in fizikalne lastnosti, se je odprlo novo področje potencialnih tveganj za žive organizme. Poleg namerno proizvedenih nanodelcev z nanotehnološkimi procesi je naše okolje zelo onesnaženo z nenamerno proizvedenimi nanodelci z izgorevanjem, transportom in industrijskimi procesi, ki poslabšujejo kvaliteto bivanja in

Content (Syllabus outline):

Development of nanotechnology based on special properties of nanoparticles, i.e. a high mobility, enhanced chemical activity and surface/volume ratio, small size, small mass, and changed chemical and physical properties, has opened a new area of potential risks for living organisms. Beside intentionally produced nanoparticles by nanotechnology processes, our environment is highly polluted by non-intentionally produced nanoparticles by combustion, transport and industrial processes, which deteriorate the quality of life and reduce life expectancy. Nanoparticles

znižujejo življenjsko dobo. Nanodelci, ki predstavljajo veliko večino t.i. trdih delcev, ki jih podajajo v enotah PM10 in PM2.5, povzročajo bolezni srca in ožilja, nekatere vrste rakavih obolenj, astmatične napade in alergije.

Predmet podaja pregled nevarnosti nanodelcev ter metod in tehnik zaščite pred temi nevarnostmi.

Predmet vključuje:

- analize nevarnosti nanodelcev v njihovem življenjskem ciklu
- redne meritve sproščanja nanodelcev in merjenje njihove kemijske sestave
- karakterizacijo lastnosti nanodelcev, vključno s potencialnimi toksičnimi učinki
- tveganja, povezana z nanotehnološkimi proizvodi

representing a large majority of particulate matter presented in the PM10 and PM2.5 units, cause cardiovascular diseases, certain types of cancer, asthma attacks and allergies.

The course presents an overview of the dangers of nanoparticles and methods of protection from these dangers.

The course includes:

- analysis of nanoparticle's risks in their life cycle
- monitoring and measurement of exposure to nanoparticles
- characterization of nanoparticle properties including the potential toxic effects
- risks associated with nanotechnological products

Temeljni literatura in viri / Readings:

»Nanotoxicity«, S.C. Sahu and D.A. Casciano, John Wiley and Sons Ltd., 2010

Zaradi hitrosti razvijajočega se področja so temeljni študijski viri objavljeni članki v zadnjih letih, predvsem v revijah Nanotoxicity, Environmental Science: Nano, Journal of Nanotoxicology and Nanomedicine, Air Quality, Atmosphere & Health.

The latest articles from scientific journals Nanotoxicity, Environmental Science: Nano, Journal of Nanotoxicology and Nanomedicine, Air Quality, Atmosphere & Health.

Cilji in kompetence:

Študenti spoznajo nevarnosti, povezane s proizvodnjo nanotehnoloških izdelkov in najnovejše dosežke na področju nanovarnosti, ter se pripravijo za raziskovalno delo na izbranih področjih nanoznanosti.

Objectives and competences:

Students learn about the risks of development of nanotechnological products and the most advanced achievements in the field of nanosafety, and prepare themselves for research work in the selected fields of nanoscience.

Predvideni študijski rezultati:

Znanje in razumevanje:

- razumevanje nanovarnosti.

Splošne sposobnosti:

- obvladanje raziskovalnih metod, postopkov in procesov,
- razvoj kritične in samokritične presoje,
- razvoj komunikacijskih sposobnosti in spretnosti, posebej komunikacije v mednarodnem okolju,
- sodelovanje, delo v skupini (v mednarodnem okolju).

Predmetne sposobnosti:

- Predmet pripravlja študente za uporabo znanja s

Intended learning outcomes:

Knowledge and understanding:

- the students will understand nanosafety.

General learning outcomes:

- the students will master research methods, procedures, and processes,
- the students will develop critical thinking,
- the students will develop communication skills to present research achievements in the international environment,
- cooperation, work in teams (in international environment).

Course-specific learning outcomes:

področja nanovarnosti.

• this course prepares students to apply knowledge of nanosafety.

Metode poučevanja in učenja:

- predavanja
- seminarji
- konzultacije

Learning and teaching methods:

- lectures
- seminar work
- consultations

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
• seminar	50 %	• seminar
• ustni izpit	50 %	• oral exam

Reference nosilca / Lecturer's references:

- REMŠKAR, Maja, TAVČAR, Gašper, ŠKAPIN, Srečo D. Sparklers as a nanohazard : size distribution measurements of the nanoparticles released from sparklers. *Air quality, atmosphere & health*, ISSN 1873-9318, 2015, vol. 8, no. 2, str. 205-211
- LANG, Andreja, OVSENIK, Maja, VERDENIK, Ivan, REMŠKAR, Maja, OBLAK, Čedomir. Nanoparticle concentrations and composition in a dental office and dental laboratory : a pilot study on the influence of working procedures. *Journal of occupational and environmental hygiene*, ISSN 1545-9624, 2018, (in press), doi: 10.1080/15459624.2018.1432864
- KRANJC, Eva, MAZEJ, Darja, REGVAR, Marjana, DROBNE, Damjana, REMŠKAR, Maja. Foliar surface free energy affects platinum nanoparticle adhesion, uptake, and translocation from leaves to roots in arugula and escarole. *Environmental science, Nano*, ISSN 2051-8153, [in press] 2017, 27 str., doi: 10.1039/C7EN00887B.
- NOVAK, Sara, DROBNE, Damjana, VACCARI, Lisa, KISKINOVA, Maya Petrova, FERRARIS, Paolo, BIRARDA, Giovanni, REMŠKAR, Maja, HOČEVAR, Matej. Effect of ingested tungsten oxide (WOX) nanofibers on digestive gland tissue of *Porcellio scaber* (Isopoda, Crustacea) : fourier transform infrared (FTIR) imaging. *Environmental science & technology*, ISSN 0013-936X. [Print ed.], 2013, vol. 47, no. 19, str. 11284-11292, doi: 10.1021/es402364w
- MILLAKU, Agron, DROBNE, Damjana, TORKAR, Matjaž, NOVAK, Sara, REMŠKAR, Maja, PIPAN TKALEC, Živa. Use of scanning electron microscopy to monitor nanofibre/cell interaction in digestive epithelial cells. *Journal of hazardous materials*, ISSN 0304-3894. [Print ed.], 15. Sep. 2013, vol. 260, str. 47-52, ilustr. <http://dx.doi.org/10.1016/j.jhazmat.2013.04.041>, doi: 10.1016/j.jhazmat.2013.04.041