

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Radioaktivni odpadki
Course title:	Radioactive Waste

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Ekotehnologije, 3. stopnja	/	1	1
Ecotechnologies, 3 rd cycle	/	1	1

Vrsta predmeta / Course type

Izbirni / Elective

Univerzitetna koda predmeta / University course code:

EKO3-768

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. Borut Smodiš
Doc. dr. Marko Štok

**Jeziki /
Languages:**

Predavanja / Lectures: slovenščina, angleščina
Slovenian, English

Seminar: angleščina
English

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

Zaključen študij druge stopnje naravoslovne ali tehniške smeri ali zaključen študij drugih smeri z dokazanim poznavanjem osnov področja predmeta (pisna dokazila, pogovor).

Prerequisites:

Completed second level studies in natural sciences or engineering or completed second level studies in other fields with proven knowledge of fundamentals in the field of this course (certificates, interview).

Vsebina:

Upravljanje in rokovanje z radioaktivnimi odpadki:

- Viri in značilnosti radioaktivnih odpadkov;
- Vrste in kategorizacija radioaktivnih odpadkov;
- Karakterizacija radioaktivnih odpadkov in radiološko kontaminiranih območij;
- Priprava, obdelava in skladiščenje radioaktivnih odpadkov;
- Prenos radionuklidov v okolju.

Content (Syllabus outline):

Radioactive waste management and handling:

- Sources and characteristics of radioactive waste;
- Radioactive waste types and classes;
- Characterization of radioactive waste and radioactively contaminated sites;
- Conditioning, processing and storage of radioactive waste;
- Radionuclide environmental transport.

Temeljni literatura in viri / Readings:

- Classification of Radioactive Waste, General Safety Guide No. GSG-1, International Atomic Energy Agency, Vienna, 2009.
- Status and trends in spent fuel and radioactive waste management, Nuclear Energy Series No. NW-T-1.14, International Atomic Energy Agency, Vienna, 2018.
- Selection of Technical Solutions for the Management of Radioactive Waste, TECDOC-1817, International Atomic Energy Agency, Vienna, 2017.
- Disposal of Radioactive Waste, Specific Safety Requirements No. SSR-5, Atomic Energy Agency, Vienna, 2011.
- Ciljani izbor znanstvenih objav. / Targeted selection of scientific publications.

Cilji in kompetence:

Cilj predmeta je osvojitve poznavanja problematike radioaktivnih odpadkov, seznanitev z izbranimi tehnikami karakterizacije in obdelave radioaktivnih odpadkov ter načinov varnega hranjenja in odlaganja.

Cilj se navezuje na kompetence:

- Obvladovanje raziskovalnih metod, postopkov in procesov ter razvoj kritične in samokritične presoje;
- Sposobnost uporabe znanja na akademski ravni in v praksi;
- Upravljanje z radioaktivnimi viri in odpadki do ravni, ki jo terja raziskovalno delo in reševanje strokovnih problemov v praksi;
- Uporaba teoretskih in eksperimentalnih metod pri razreševanju problemov, povezanih z upravljanjem z radioaktivnimi odpadki.

Objectives and competences:

The objective of the course is to gain an in-depth knowledge and understanding of issues related to radioactive waste, as well as acquaintance with the selected techniques of characterization and conditioning of radioactive waste, and methods for their safe storage and disposal into the environment.

This objective is related to the competences:

- Command of research methods, procedures and processes, and well-formed skills for critical judgment;
- Critical thinking at both academic level and in practice;
- Ability to manage radioactive sources and waste to the level required by research work as well as solving professional problems in practice;
- Ability to apply theoretical and experimental methods in solving problems related to radioactive waste management.

Predvideni študijski rezultati (Izidi):

- Razumeti principe rokovanja z radioaktivnimi snovmi;
- Poznati vire, vrste in kategorije radioaktivnih odpadkov;
- Izbrati ustrezne metodologije in tehnike za karakterizacijo radioaktivnih snovi;
- Pojasniti postopke za obdelavo, procesiranje in skladiščenje radioaktivnih odpadkov;
- Presoditi izbiro ustreznih postopkov za upravljanje s posameznimi vrstami radioaktivnih odpadkov;
- Napovedati procese transporta radionuklidov v okolju;
- Vzpostaviti sposobnost komunikacije v angleškem jeziku na področju ravnanja z radioaktivnimi odpadki.

Intended learning outcomes:

- Understand principles of handling radioactive substances;
- Know origin, types and classes of radioactive waste;
- Select appropriate methodologies and techniques for the characterization of radioactive substances;
- Explain procedures for conditioning, processing and storage of radioactive waste;
- Judge appropriate procedures for management of particular types of radioactive waste;
- Predict transport processes for radionuclides in the environment;
- Establish the ability to communicate in English in the field of radioactive waste management.

Metode poučevanja in učenja:

Predavanja.
Seminarsko delo.
Vključevanje v projekte za reševanje izbranih problemov.
Priprava seminarske predstavitve.

Learning and teaching methods:

Lectures.
Seminar work.
Participation in projects for solving selected problems.
Preparation of the seminar presentation.

Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

Seminarska naloga.	50 %	Seminar work.
Zagovor seminarske naloge, pri katerem študent dokaže osvojitve vseh študijskih izidov z vsaj po enim konkretnim primerom.	50 %	Defence of the seminar work where the student demonstrates the achievement of all learning outcomes with at least one specific case for each outcome.

Reference nosilca / Lecturer's references:

- PLANINŠEK, Petra, SMODIŠ, Borut, BENEDIK, Ljudmila. Simultaneous determination and uptake assessment of selected radionuclides in plants grown in substrate contaminated with U-mill tailings. *Journal of radioanalytical and nuclear chemistry*, ISSN 0236-5731, 2016, vol. 309, no. 1, str. 351-365, doi: [10.1007/s10967-016-4881-7](https://doi.org/10.1007/s10967-016-4881-7).
- MATVEYEVA, Ilona, JAČIMOVIĆ, Radojko, PLANINŠEK, Petra, SMODIŠ, Borut, BURKITBAYEV, Mukhambetkali. Uptake of uranium, thorium and radium isotopes by plants growing in dam impoundment Tasotkel and the Lower Shu region (Kazakhstan). *Radiochimica Acta*, ISSN 0033-8230, 2016, vol. 104, iss. 1, str. 51-57, doi: [10.1515/ract-2015-2457](https://doi.org/10.1515/ract-2015-2457).
- SMODIŠ, Borut, ČERNE, Marko, JAČIMOVIĆ, Radojko, BENEDIK, Ljudmila. Transfer of uranium and radium to Chinese cabbage from soil containing elevated levels of natural radionuclides. *Journal of radioanalytical and nuclear chemistry*, ISSN 0236-5731, 2015, vol. 306, iss. 3, str. 685-694, doi: [10.1007/s10967-015-4198-y](https://doi.org/10.1007/s10967-015-4198-y).
- SMODIŠ, Borut, ŠTOK, Marko, ČERNE, Marko. Radioecology around a closed uranium mine. *Journal of radioanalytical and nuclear chemistry*, ISSN 0236-5731, 2014, vol. 299, issue 1, str. 765-771, doi: [10.1007/s10967-013-2697-2](https://doi.org/10.1007/s10967-013-2697-2).
- MATVEYEVA, I., JAČIMOVIĆ, Radojko, PLANINŠEK, Petra, STEGNAR, Peter, SMODIŠ, Borut, BURKITBAYEV, Mukhambetkali. Assessment of the main natural radionuclides, minor and trace elements in soils and sediments of the Shu valley (near the border of Kazakhstan and Kyrgyzstan). *Journal of radioanalytical and nuclear chemistry*, ISSN 0236-5731, 2014, vol. 299, issue 3, str. 1399-1409.