

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	KARAKTERIZACIJA IN STABILNOST MATERIALOV KULTURNE DEDIŠČINE
Course Title:	CHARACTERISATION AND STABILITY OF MATERIALS FROM CULTURAL HERITAGE

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Kemija, 2. stopnja	/	2.	4.
USP Chemistry, 2 nd Cycle	/	2 nd	4 th

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: K2I15

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	30	/	/	/	75	5

Nosilec predmeta / Lecturer: izr. prof. dr. Irena Kralj Cigić / Dr. Irena Kralj Cigić, Associate Professor
prof. dr. Matija Strlič / Dr. Matija Strlič, Full Professor

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

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.

Vsebina:

Materiali kulturne dediščine – uvod.
Osnove študija materialov kulturne dediščine – razumevanje kompleksnosti nehomogene in nedoločene sestave naravnih in naravno staranih materialov, starosti (metode datiranja) in provenience (arheometrija).
Stabilnost materialov kulturne dediščine.
Termoliza. Termooksidacija. Procesi razgradnje materialov pod vplivom kisika, avtooksidacija, antioksidanti. Fotoliza in fotooksidacija.
Razgradnja pod vplivom onesnaževal. Vpliv SO₂, ozona, NO_x.
Metode stabilizacije materialov kulturne dediščine.

Content (Syllabus outline):

Cultural heritage materials – introduction.
Fundamentals of cultural heritage material studies – understanding of the complexity of inhomogeneous composition of natural and naturally aged materials, age (methods of dating) and provenience (archaeometry).
Stability of cultural heritage materials.
Thermolysis. Thermoxydation. Degradation processes of materials influenced by oxygen, autoxidation, antioxidants. Photolysis and photodegradation. The influence of pollutants. Influence of SO₂, ozone, NO_x.
Methods of stabilisation of cultural heritage materials.

Metode za študij trajnosti materialov kulturne dediščine.

Pospešena razgradnja, modelni eksperimenti in eksperimenti v realnem okolju.

Analitika in karakterizacija razgradnih produktov, kinetika razgradnje, modeliranje, kontrolirana razgradnja. Modeliranje življenjske dobe.

Metode za karakterizacijo materialov kulturne dediščine.

Porušne in neporušne metode, definicija.

Mikrovzorčevanje, prostorska resolucija in specifičnost. Prenosna instrumentacija.

Kolorimetrija, rentgenske metode, spektroskopija infrardeče svetlobe, metode na osnovi laserjev, kromatografske metode.

Lasersko oslikovanje (skeniranje) predmetov, stavb, prostorov in izdelava 3D modelov.

Monitoring okoljskih parametrov

Senzorji za svetlobo, indikatorji (dozimetri) in analizne metode za spremljanje kemijskih onesnaževal.

Studies of durability of cultural heritage materials.

Methods of accelerated ageing, model experiments and experiments in real environment. Analytical methods and characterisation of degradation products, kinetics of degradation, modelling, controlled degradation. Modelling of lifetime.

Methods for cultural heritage material characterisation.

Destructive and non-destructive methods – definitions. Microsampling, spatial resolution and specificity. Portable instrumentation.

Colourimetry, X-ray methods, IR spectroscopy, laser-based analytical methods, chromatographic methods.

Laser scanning of objects, buildings and spaces and 3D imaging.

Monitoring of environmental parameters.

Light sensors, indicators (dosimeters) and analytical methods for analysis of indoor and outdoor pollutants.

Temeljna literatura in viri / Readings:

- M. Schreiner, M. Strlič: Handbook on the use of lasers in conservation and conservation science, COST, 2006. (elektronski vir)

- E. Ciliberto, G. Spoto, Modern analytical methods in art and archaeology. New York: John Wiley & Sons, 2000, 755 str. (25 %)

Dodatna literatura:

- Norman S. Allen, M. Edge, Fundamentals of Polymer Degradation and Stabilisation, Springer, 2001.

- Članki iz znanstvenih in strokovnih revij.

Cilji in kompetence:

Cilji: Študent se pri predmetu usposobi za raziskovalno delo na področju študija materialov kulturne dediščine, z upoštevanjem konteksta uporabe materiala in naravnih razgradnih procesov.

Kompetence: Obravnava in uporaba specifičnih metod vzorčenja, analiznih metod in metod študija trajnosti materialov je povezana z obravnavano problematiko (case-studies) in nadgrajuje študentova predhodna znanja.

Objectives and Competences:

Learning outcomes:

To gain knowledge of cultural heritage materials and fundamental analytical techniques in use for their characterisation. The student gains knowledge of environmental parameters affecting the lifetime expectancy of heritage materials and about the typical degradation processes.

Competences:

The course builds on case-studies and will provide an overview of sampling techniques,

--

analytical methods and durability studies and thus builds on previous knowledge of chemistry and material science.
--

Predvideni študijski rezultati:

<p><u>Znanje in razumevanje</u> Študent bo razumel osnovne zakonitosti materialov kulturne dediščine - pojem trajnosti, razgradnje, življenjske dobe, zakonitosti razgradnih procesov in proceseter postopke razvoja procesov stabilizacije. Poznal bo osnovne postopke karakterizacije in evaluacije analiznih rezultatov.</p>
<p><u>Uporaba</u> Študent bo znal uporabiti principe oz. zakonitosti na primerih, ter znal poiskati povezave s prakso. Znal bo utemeljiti razvoj novih postopkov stabilizacije.</p>
<p><u>Refleksija</u> Znal bo kritično ovrednotiti skladnosti med prakso in teorijo, neskladnosti bo znal evaluirati.</p>
<p><u>Prenosljive spretnosti</u> - sintetično, analitično, ustvarjalno mišljenje in reševanje problemov analitike in karakterizacije kulturne dediščine - uporaba znanja v praksi - iniciativnost/ ambicioznost, - osebna odgovornost in odgovornost do skupine, - vrednota stalnega osebnega strokovnega napredovanja</p>

Intended Learning Outcomes:

<p><u>Knowledge and Comprehension</u> To gain understanding of basic principles of cultural heritage materials- terms of durability, degradation, lifetime, principles of degradation processes and procedures for development of conservation procedures.</p>
<p><u>Application</u> To gain application of principle on real cases and to find connections with practical use. To validate development of new conservation procedures.</p>
<p><u>Analysis</u> To critically evaluate consistency between theory and practice and to evaluate differences</p>
<p><u>Skill-transference Ability</u> - synthetic, analytical, creative thinking and solving analytical problems and characterisation of cultural heritage -application of knowledge in practice -initiative / ambition -personal responsibility and group responsibility -values of permanent personal and professional progression</p>

Metode poučevanja in učenja:

<p>Predavanja, ki vključujejo strokovne ekskurzije v raziskovalne inštitucije.</p> <p>Seminar: skupinsko in individualno projektno delo na izbrano tematiko, pisanje seminarske naloge, ustna predstavitev.</p>

Learning and Teaching Methods:

<p>Lectures including visits of research institutions.</p> <p>Seminar: team and individual project work on selected theme, writing of seminar, oral presentation.</p>

Delež (v %) /

Načini ocenjevanja:**Weight (in %) Assessment:**

Seminar	40%	Seminar
Pisni izpit	60%	Written exam
Ocenjevanje: 6-10 (pozitivno), 1-5 (negativno)		Grading scale: 6-10 (pozitive), 1-5 (negative)

Reference nosilca / Lecturer's references:

- M. Strlič, I. Kralj Cigić, J. Kolar, G. De Bruin, B. Pihlar. Non-destructive evaluation of historical paper based on pH estimation from VOC emissions. *Sensors*, 7 (2007) 3136-3145.
- M. Strlič, J. Thomas, T. Trafela, L. Csefalvayova, I. Kralj Cigić, J. Kolar, M. Cassar. Material degradomics : on the smell of old books. *Analytical chemistry*, 81 (2009) 8617-8622.
- K. L. Rasmussen, J. Gunneweg, J. Van Der Plicht, I. Kralj Cigić, A. D. Bond, B. Svensmark, M. Balla, M. Strlič, G. L. Doudna. On the age and content of Jar-35: a sealed and intact storage jar found on the southern plateau of Qumran. *Archaeometry*, 53 (2011) 791-808.
- DURAN-CASABLANCAS, Cristina, GRAU-BOVÉ, Josep, FEARN, Tom, STRLIČ, Matija. Accumulation of wear and tear in archival and library collections. Part 2, An epidemiological study. *Heritage science*, ISSN 2050-7445, Mar. 2019, vol. 7, str. 1-14, doi: 10.1186/s40494-019-0253-2.
- LIU, Yun, KRALJ CIGIĆ, Irena, STRLIČ, Matija. Kinetics of accelerated degradation of historic iron gall ink-containing paper. *Polymer degradation and stability*, ISSN 0141-3910, Aug. 2017, vol. 142, str. 255-262, doi: 10.1016/j.polymdegradstab.2017.07.010.
- MAHGOUB, Hend, BARDON, Tiphaine Blandine, LICHTBLAU, Dirk Andreas, FEARN, Tom, STRLIČ, Matija. Material properties of Islamic paper. *Heritage science*, ISSN 2050-7445, Nov. 2016, vol. 4, str. 1-14, ilustr. doi: 10.1186/s40494-016-0103-4.
- ORIOLA, Marta, MOŽIR, Alenka, GARSIDE, Paul, CAMPO, Gema, NUALART-TORROJA, Anna, CIVIL, Irene, ODLYHA, Marianne, CASSAR, May, STRLIČ, Matija. Looking beneath Dalí's paint : non-destructive canvas analysis. *Analytical methods*, ISSN 1759-9660, 2014, vol. 6, iss. 1, str. 86-96. doi: 10.1039/C3AY41094C.
- MOŽIR, Alenka, KRALJ CIGIĆ, Irena, MARINŠEK, Marjan, STRLIČ, Matija. Material properties of historic parchment : a reference collection survey. *Studies in conservation : the journal of the International Institute for Conservation of Historic and Artistic Works*, ISSN 0039-3630, May 2014, vol. 59, no. 3, str. 136-149. doi: 10.1179/2047058413Y.0000000100.