AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Conservation science for heritage protection

Academic year: 2019/2020 Code: ZSDA-3-0015-s ECTS credits: 4

Faculty of: Szkoła Doktorska AGH

Field of study: Szkoła Doktorska AGH Specialty: —

Study level: Third-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 0

Course homepage: http://home.agh.edu.pl/~lojewski

Responsible teacher: dr hab. Łojewski Tomasz (lojewski@agh.edu.pl)

Module summary

The course presents an overview of instrumental analysis methods applied to cultural heritage artefacts and some topics characteristic for CH studies, incl. degradation mechanisms for selected classes of materials, methodology of accelerated ageing, dating and advanced imaging techniques. Lectures are illustrated with many examples and supported by laboratory exercises in which students will have an opportunity to perform tests for heritage objects with the use of a state-of-the-art equipment.

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence: is able to			
M_K001	Student is able to recognize the role of material science and analytical chemistry in protection of cultural heritage	SDA3A_K01, SDA3A_K02	Activity during classes
M_K002	Student understands risks coming from inproper conservation and exhibition practises as well as poorly designed physicochemical studies to the stability and visual appearance of artefacts in heritage/art collections	SDA3A_K01	Activity during classes
M_K003	Student could characterize analytical methods suitable for nondestructive studies of heritage objects	SDA3A_K01, SDA3A_K03	

M_K004	Student is able to choose appropriate analytical methods to solve problem related to active and passive conservation of artworks and heritage objects	SDA3A_K03, SDA3A_K02	
Skills: he can			
M_U001	Student has a working knowledge concerning key analytical techniques applied in the field of conservation science	SDA3A_U03, SDA3A_U02, SDA3A_U01	Activity during classes
M_U002	Student could identify treaths to the stability and visual appearance of museum objects	SDA3A_U02, SDA3A_U01	
M_U003	Student can formulate a study plan of physicochemical analyses for historical artefacts and art objects	SDA3A_U06, SDA3A_U03, SDA3A_U02, SDA3A_U01, SDA3A_U04	
Knowledge: he knows and understands			
M_W001	Student could describe degradation mechanisms for selected classes of materials in heritage collections	SDA3A_W03, SDA3A_W01	

Number of hours for each form of classes

	Form of classes										
Suma	Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
45	30	0	15	0	0	0	0	0	0	0	0

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
Social competence: is able to												
M_K001	Student is able to recognize the role of material science and analytical chemistry in protection of cultural heritage	+	-	-	-	-	-	-	-	-	-	-

M_K002	Student understands risks coming from inproper conservation and exhibition practises as well as poorly designed physicochemical studies to the stability and visual appearance of artefacts in heritage/art collections	+	-	-	-	-	-	-	-	-	-	-
M_K003	Student could characterize analytical methods suitable for nondestructive studies of heritage objects	+	-	+	-	-	-	-	-	-	-	-
M_K004	Student is able to choose appropriate analytical methods to solve problem related to active and passive conservation of artworks and heritage objects	+	-	+	-	-	-	-	-	-	-	-
Skills: he can												
M_U001	Student has a working knowledge concerning key analytical techniques applied in the field of conservation science	-	-	-	-	-	-	-	-	-	-	-
M_U002	Student could identify treaths to the stability and visual appearance of museum objects	-	-	-	-	-	-	-	-	-	-	-
M_U003	Student can formulate a study plan of physicochemical analyses for historical artefacts and art objects	-	-	-	-	-	-	-	-	-	-	-
Knowledge: he knows and understands												
M_W001	Student could describe degradation mechanisms for selected classes of materials in heritage collections	-	-	-	-	-	-	-	-	-	-	-

Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	45 h
Preparation for classes	30 h
przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania	5 h
Realization of independently performed tasks	5 h
Contact hours	2 h
Inne	3 h
Summary student workload	90 h
Module ECTS credits	4 ECTS

Additional information

Module content

Lectures

Lectures presenting an overview of instrumental analysis methods applied to cultural heritage (CH) artefacts and selected topics characteristic for CH studies:

Introduction to conservation science
Degradation mechanisms for selected classes of materials in collections
Separation techniques (chromatography, electrophoresis)
Spectroscopic analysis (infrared, Raman and mass spectroscopy)
Accelerated aging
Microbial corrosion and disinfection
Dating of historical materials
Theory and practice of color measurement
Imaging techniques in CH studies

Laboratory classes

Laboratory excercises:
1. Accelerated light aging
2. Colour measurement
3. Multispectral imaging and reflectance transformation imaging
4. Nondestructive elemental analysis for CH objects with XRF spectrometer
5. Visit to a museum laboratory

Teaching methods and techniques:

Lectures: Lectures illustrated with examples from museum studies relevant to presented topics
Laboratory classes: hands-on laboratory class with state-of-the-art specialized equipment for non-destructive analysis of heritage objects

Warunki i sposób zaliczenia poszczególnych form zajęć, w tym zasady zaliczeń poprawkowych, a także warunki dopuszczenia do egzaminu:

Lectures: participations in lectures
Laboratory classes: participation and preparation of the written work on one selected topic from the presented list.

Zasady udziału w poszczególnych zajęciach, ze wskazaniem, czy obecność studenta na zajęciach jest obowiązkowa:

Lectures:
– Attendance is mandatory: Yes
– Participation rules in classes: obligatory, max of 2 absences
Laboratory classes:
– Attendance is mandatory: Yes
– Participation rules in classes: obligatory, max of 1 absence

Method of calculating the final grade

no grades, pass/no pass only

Sposób i tryb wyrównywania zaległości powstałych wskutek nieobecności studenta na zajęciach:

Nie określono

Prerequisites and additional requirements

It is expected that student enrolling for this course will:
- have at least basic knowledge in chemistry and physics,
- show interest in humanities (archeology, museology, history of art and art conservation),
- have good command of English.

Recommended literature and teaching resources

1. Evangelia A. Varella, Conservation Science for the Cultural Heritage: Applications of Instrumental Analysis, Springer 2013
2. E. Ciliberto, G. Spoto, Modern Analytical Methods in Art and Archaeology, Wiley-Interscience 2000
3. Barbara H. Stuart, Analytical Techniques in Materials Conservation, John Wiley & Sons 2007
4. H.M. Szczepanowska, Conservation of Cultural Heritage: Key Principles and Approaches, Routledge 2013
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publications from the Getty Conservation Institute, many of which are available on-line in full text (some examples below):
5. Ruth Johnston-Feller, Color Science in the Examination of Museum Objects: Nondestructive Procedures, GCI 2001
6. Robert L. Feller, Accelerated Aging: Photochemical and Thermal Aspects, GCI 1994
7. Michele R. Derrick, Dusan Stulik, and James M. Landry, Infrared Spectroscopy in Conservation Science, GCI 1999
8. Terry J. Reedy and Chandra L. Reedy, Principles of Experimental Design for Art Conservation Research, GCI 1992

Scientific publications of module course instructors related to the topic of the module

1. Chlebda, D.K., Majda, A., Łojewski, T., Łojewska, J. Hyperspectral imaging coupled with chemometric analysis for non-invasive differentiation of black pens (2016) Applied Physics A: Materials Science and Processing, 122 (11)
2. Pawcenis, D., Smoleń, M., Aksamit-Koperska, M.A., Łojewski, T., Łojewska, J., Evaluating the impact of different exogenous factors on silk textiles deterioration with use of size exclusion chromatography (2016) Applied Physics A: Materials Science and Processing, 122 (6)
3. Pawcenis, D., Syrek, M., Aksamit-Koperska, M.A., Łojewski, T., Łojewska, J., Mark-Houwink-Sakurada coefficients determination for molar mass of silk fibroin from viscometric results. SEC-MALLS approach (2016) RSC Advances, 6 (44)
4. Koperska MA, Lojewski T, Lojewska J, Evaluating degradation of silk's fibroin by attenuated total reflectance infrared spectroscopy: Case study of ancient banners from Polish collections, Spectrochimica Acta Part A-Molecular and Biomolecular Spectroscopy 2015, 135, 576-582
5. Koperska MA, Pawcenis D, Milczarek JM, Blachecki A, Łojewski T, Łojewska J, Fibroin degradation – Critical evaluation of conventional analytical methods, Polymer Degradation and Stability 2015, 120 357-36
6. Pawcenis D, Thomas JL, Łojewski T, Milczarek JM, Łojewska J, Towards determination of absolute molar mass of cellulose polymer by size exclusion chromatography with mulitple angle laser light scattering detection, J Chromatogr A. 2015, 1409:53-9
7. Pawcenis, D., Koperska, M.A., Milczarek, J.M., Łojewski, T., Łojewska, J., Size exclusion chromatography for analyses of fibroin in silk: Optimization of sampling and separation conditions, 2014, Applied Physics A: Materials Science and Processing, 114(2), s. 301-308
8. Koperska, M.A., Pawcenis, D., Bagniuk, J., Zaitz, M.M., Missori, M., Łojewski, T., Łojewska, J., Degradation markers of fibroin in silk through infrared spectroscopy, 2014, Polymer Degradation and Stability, 105(1), s. 185-196
9. T. Łojewski, La désacidification de masse en Pologne, Bibliothèque nationale de France, Actualités de la conservation 2012, 31, p. 1-2
10. T. Łojewski, J. Bagniuk, A. Kołodziej, J. Łojewska, Reflective and photoacustic infrared spectroscopic techniques in assessment of binding media in paintings, Appl. Physics A: Materials 105(3) (2011)753-761
11. T. Łojewski, J. Thomas, R. Gołąb, J. Kawałko, J. Łojewska, Light ageing with simultaneous colorimetry via fiber optics reflection spectrometry, Rev. Sci. Instrum. 82(7) (2011) 076102-1 – 076102-3
12. T. Łojewski, K. Zięba, A. Kołodziej, J. Łojewska, Following cellulose depolymerization in paper: comparison of size exclusion chromatography techniques, Cellulose 18 (2011) 1349–1363
13.Koperska. T. Łojewski, J. Łojewska, Vibrational spectroscopy techniques to study degradation of

natural dyes. Assessment of oxygen free cassette for safe exposition of artifacts, Analytical Bioanalytical Chemistry 399 (2011) 3271-3283
14. T. Łojewski, P. Miśkowiec, M. Missori, A. Lubańska, L.M. Proniewicz, J. Łojewska, FTIR and UV/VIS as methods for evaluation of oxidative degradation of cellulose. DFT approach to carbonyl vibrations, Carbohydrate Pol. 82(2) (2010) 370-375
15. 11. T. Łojewski, K. Zięba. J. Łojewska, Size exclusion chromatography and viscometry in paper degradation studies. New Mark-Houwink coefficients for cellulose in cupriethylenediamine, J. Chromatogr. A 1217(42) (2010) 6462-6468

Additional information

None