UNIVERSITA' DEGLI STUDI DI BOLOGNA

MASTER DEGREE COURSE

SCIENCE FOR THE CONSERVATION-RESTORATION OF CULTURAL HERITAGE

(SCORE)

ACADEMIC YEAR 2023-2024

APPLICATION FOR INTERNSHIPS AIMED AT IMPLEMENTING THE EXPERIMENTAL THESIS PERIOD OF SIX MONTHS ABROAD

Thanks to a generous contribution from Fondazione Flaminia in Ravenna (http://www.fondazioneflaminia.it), 2 scholarships are offered to students enrolled into the 2nd year of the SCORE Master degree programme who intend to implement their experimental thesis outside of Italy.

The first two candidates of the final ranking list may choose one of the experimental projects described in ANNEX 1.

fourth

Eligibility
Internships are open to students enrolled into the 2nd year of the SCORE Master degree programme. Applicants should:

- have completed at least 42 Credits of the SCORE programme
- be fluent in English
- have an arithmetic average course examination score ≥ 26/30
- not be resident in the country where the selected project will be developed[1]

Terms
Successful applicants will get, directly from Fondazione Flaminia Ravenna, a grant amount of 2500,00 € as a contribution for the entire duration of their stay abroad. If, for any reason, it will not be possible to complete the period abroad the scholarship will be reduced proportionally.

Application deadline is February 19th at 18:00

Materials received after this date will result in an incomplete application.

[1] Students may apply for projects that will be developed in their own country but they are not eligible for scholarships

How To Apply

- Complete and submit via email to Prof. Giorgia Sciutto (giorgia.sciutto@unibo.it) your application (ANNEX 2). Applicants have to choose among all the research proposal titles by indicating a maximum of 3 with a priority order. The 3 options indicated cannot refer to the same host institution.
- Submit an auto certification of your academic records (downloadable from the University website) with the indication of the score of each course examination and the arithmetic average course score value.
- Submit a personal statement (written in English) indicating the reasons why you want to implement your research project abroad as well as your motivations
- Submit a short Curriculum Vitae

Evaluation

Applications will be evaluated by a Scholarship Commission nominated by the SCORE Steering Committee.

The Commission will:

- Verify that the applications are complete in all the required documentation
- Make sure applicants comply with the eligibility criteria
- Make a selection of possible successful candidates to be interviewed in order to verify also the level of knowledge of their English speaking and writing.

Successful candidates to be interviewed will be notified through e-mail by February 21st

Interviews will take place on TEAMS, on February 22nd at 2:30 p.m.

For **technical assistance** please contact prof. Giorgia Sciutto (giorgia.sciutto@unibo.it)

According with D.lgs 30.6.2003 n. 196, candidate personal data will be treated exclusively for the purpose of the selection.

Ravenna, 30/01/2024

ANNEX 1: LIST OF EXPERIMENTAL PROJECTS AND HOST INSTITUTIONS

SUPERVISOR	TITLE	INSTITUTION	PRIORITY
Katrien Keune	*Evaluation of the performance of different tissues for the removal of varnishes form paintings*	Universiteit van Amsterdam	
Łukasz Bratasz	*Determination of a safe range of relative humidity variations for paintings with craquelures using Finite Element modelling*	Instytut Katalizy i Fizykochemii Powierzchni im. Jerzego Habera Polskiej Akademii Nauk (Krakow)	
Łukasz Bratasz	*Evaluation of the stress fields in contemporary art objects made of poly(vinyl chloride) - (PVC) caused by migration of plasticizer*	Instytut Katalizy i Fizykochemii Powierzchni im. Jerzego Habera Polskiej Akademii Nauk (Krakow)	
Łukasz Bratasz	*Developing mechanical degradation model of inflatable PVC objects*	Instytut Katalizy i Fizykochemii Powierzchni im. Jerzego Habera Polskiej Akademii Nauk (Krakow)	
Vanessa Otero	*1) Investigating the 19th-century manufacture of madder lake pigments* *2) Studying the stability of historical formulations of madder lake pigments*	Nova University, Lisbon	
Artur Neves	*Material and historical ties: investigating the interactions between celluloid and textiles in cultural artefacts*	Nova University, Lisbon	
Paula Nabais	*The Yellows and Oranges of Antoine Janot & Paul Gout*	Nova University, Lisbon	
Silvia Pereira	*1- Disclosing the tile production of the Portuguese Golgen Age Masters* *2 - Consolidation of glazed surfaces*	The National Laboratory for Civil Engineering (LNEC)	

Tim De Kock	*Black Crusts as Geochemical Archives: Reconstructing Urban Anthropogenic Pollution*	University of Antwerp	
Federica Cappa	*The role of copper and zinc in the formation, structure and degradation patterns of Iron-gall inks*	Institute of Natural Sciences and Technology in the Arts (Vienna)	
Federica Cappa	*Iron-polyphenolic complexes occurring in Iron-gall inks: accessing the variability of structures and properties*	Institute of Natural Sciences and Technology in the Arts (Vienna)	

HOST SUPERVISOR: KATRIEN KEUNE
UNIBO SUPERVISOR: SILVIA PRATI
Evaluation of the performance of different tissues for the removal of varnishes form paintings

Non-woven tissues have emerged as promising tools for the removal of varnishes from oil paintings. These innovative materials offer a multitude of advantages when compared to conventional cotton swabs, primarily revolving around their capacity to minimize solvent exposure and mitigate potential damage to the delicate paint surface.
In the frame of the GoGreen project the use of non-woven tissues is under exploration with the aim of using them as carrier of green solvents and of finding strategies to develop them in the most sustainable and eco-friendly manner. A comparison between the performances of materials produced in the frame of the consortium and of the commercially available Evolon® is actually under evaluation.
Within this thesis project different tissues will be used to remove natural varnishes from oil paintings and different analytical techniques such as UV, FTIR and laser speckle imaging techniques will be employed for the evaluation of the cleaning efficacy and of the effects of the cleaning method on the treated surface.

HOST SUPERVISOR: ŁUKASZ BRATASZ
UNIBO SUPERVISOR: SILVIA PRATI
Determination of a safe range of relative humidity variations for paintings with craquelures using Finite Element modelling
The proposed project aims to further develop a 3D physical model of paintings with craquelure patterns and through this decisively contribute to the development of evidence-based environmental specifications in museums. A global topological model of cracked painting will be developed for paintings on wood and canvas using finite element analysis. The model will reproduce representative patterns of the cracked pictorial layers and will account for crack periodicity, crack thickness and material properties of historical/aged materials and/or consolidants.
The real-time deformation in response to RH variations and the resulting dynamic strain and stress fields will be analysed. The safe ranges of relative humidity variations for paintings with craquelures will be determined by subjecting the model of a painting to virtual RH changes of varying amplitude and duration, calculating the energy release rate for the existing crack tips and comparing this data with critical values of fracture toughness obtained experimentally.

HOST SUPERVISOR: ŁUKASZ BRATASZ
UNIBO SUPERVISOR: SILVIA PRATI/GIORGIA SCIUTTO

Evaluation of the stress fields in contemporary art objects made of poly(vinyl chloride) - (PVC) caused by migration of plasticizer

The project can have two distinct components necessary for achieving the main objectives – the development of effective preventive conservation strategies. The one will focus on the determination of the mechanical properties of PVC using the tensile tests together with dynamic mechanical analysis (DMA) as well as thermal properties of the PVC objects using differential scanning calorimetry (DSC) providing information about a distribution in Tg value, which can be correlated with plasticizer distribution using SEM-EDS (elemental mapping) or nanoindentation. This is the critical link determining the structure-properties relationship that places objects at risk for irreversible deformation. In this macroscale model, a variation in glass transition temperature caused by the migration of the plasticizer is also related to differences in material moduli at certain conditions. Differences in mechanical properties across the material are inherently related to stress development which can be captured using an elasto-plastic model using the finite element method and quantifying the risks of deformation and cracking based on environmental conditions which will be leveraged to construct this model in the COMSOL Multiphysics software. In order to ensure that our model is capturing real physical processes, predicted deformations will be compared to real historic objects made of PVC and optimized if necessary. The aim of this modeling would be to define fitness-for-use criteria necessary in the development of preservation strategy at an intuitional level. Fitness-for-use criteria will be developed for typical museum use scenarios: objects on exhibition, in storage, and during transportation.

HOST SUPERVISOR: ŁUKASZ BRATASZ
UNIBO SUPERVISOR: ALESSANDRA BONAZZA

Developing mechanical degradation model of inflatable PVC objects

Previously, in the PVCare project, the key parameters describing plasticizer transport in PVC were determined. This enabled the development of a plasticizer migration model with key parameters relevant for preventive conservation. Additionally, elasticity moduli, strength and strain at break were determined, allowing to define temperature-time shift factor that allowed to translate of mechanical parameters obtained at various temperatures into parameters describing long-term loadings.
During this project, all the above data will be used to develop a 2D finite element model of an inflatable object subjected to gravitational loads using COMSOL Multiphysics software. The heat transfer module will be used to model the migration of the plasticizer under various environmental conditions, and the structural mechanics module will be used to calculate the stress concentration in areas where inflatable objects fold under gravitational loads.
The obtained results will be compared with the critical strain/stress values determined in the previous test. Later, the creep test of plasticized and rigid PVC will be performed to determine critical stress levels leading to unstable behaviour of the material and refine critical parameters defined so far. The developed model will be used to determine damage function for objects made of PVC defined as time to reach critical level of strain/stress in inflatable object. Based on the computational model, environmental conditions in typical museums, storage, and historical houses will be evaluated as well as several preventive environmental management strategies.

HOST SUPERVISOR: VANESSA OTERO, Nova University Lisbon

1) Investigating the 19th-century manufacture of madder lake pigments
This project will focus on investigating the historical formulations of madder lake pigments created by Winsor & Newton (W&N), one of the leading paint manufacturers in the 19th century that supplied renowned artists such as J. M. W. Turner (1775-1851) and Amadeo de Souza-Cardoso (1887-1918). Recipes found in the W&N 19th Century Archive Database will be reproduced in the laboratory enabling the rationalisation of the manufacturing conditions from the pH of extraction, pH of precipitation, and the ingredients, including the different complexing agents and the additives used. The resulting madder lake pigments will be characterised through a multi-analytical approach, and the data will be compared with the information derived from historical samples.

2) Studying the stability of historical formulations of madder lake pigments
This project will carry out photochemical (irradiation experiments) and photophysical studies using REDiscover references prepared in the laboratory according to Winsor & Newton 19th-century recipes. The study of the mechanisms occurring after light absorption is complex and presents a major challenge in heterogeneous systems such as those found in artworks. Through the physicochemical characterisation of samples artificially aged (of pure pigments and prepared as paints), it will be possible to identify the key factors and mechanisms that promote degradation and create the basis for developing a predictive model to evaluate the state of conservation and original colour of madder lake pigments in heritage objects.

HOST SUPERVISOR: ARTUR NEVES

Material and historical ties: investigating the interactions between celluloid and textiles in cultural artefacts
This project will focus on historical relationships and chemical interactions of celluloid and textile materials. Celluloid, the first semisynthetic plastic, composed of cellulose nitrate and additives, generally camphor, was invented in 1870 by John Wesley Hyatt, USA, and was a significant material in the consumer market until the 1960s. Surviving celluloid objects are testimonies of a unique historical period, the transition from the natural to synthetic materials, and were collected by prominent cultural institutions, such as the Smithsonian Institution. As cultural heritage, due to its dangerous degradation mechanisms, celluloid became one of the perennial problems for the conservation community and there is an urgency in developing innovative, efficient, and sustainable conservation strategies. To achieve this purpose, it is fundamental to fully understand celluloid heritage materiality, both historically and chemically.
In this project, the student will have the opportunity to study objects from the Perlov celluloid collection at NOVA/FCT, Portugal, a collection composed of 300 objects donated by Dadie Perlov, the main donor of the Smithsonian Institution collection. In addition to the concerns for celluloid conservation, this collection holds other materials which also demand attention and care, namely textiles. Therefore, this project will focus on objects where these two materials "communicate".
The student will characterize the celluloid and textile compositions (polymers and additives, for example plasticizers and dyes) with a multi-analytical approach consisting of X-Ray fluorescence spectroscopy (XRF), Fourier Transformed Infrared spectroscopy (FTIR), Raman spectroscopy (if required Surface-enhanced Raman spectroscopy), molecular fluorescence in the UV-VIS, and high-performance liquid chromatography coupled with a diode array detector (HPLC-DAD).
One of the goals of the student will be to develop dating methodologies based on the compositions analyzed. Most of the celluloid objects of the Perlov Collection are not dated with precision (1870-1960). However, this period was rich in the development of new synthetic fibers, plasticizers,

pigments, and dyes and other additives. These materials were often patented in specific dates and can be used to decrease the dating range of the celluloid objects. Therefore, the student will have to proceed with a literature review to build a material chronology.
The second goal will be to address the degradation reactions between celluloid and the textiles identified. Do the degradation mechanisms of cellulose nitrate accelerate the degradation of the textile fibers? Which textile fibers are more susceptible? The natural, such as cotton or silk, or the synthetic, such as cellulose acetate or Nylon? To answer these questions, the student will be trained in methods to study polymer degradation using FTIR, for example with the degradation of references in acid environments and the quantification of cellulose nitrate degree of substitution.
Finally, the student will have the prime task of establishment the best conservation methods for the celluloid objects studied, namely pertaining their storage and exhibition. The final goal of the "Plastics Metamorphoses - the reality and the multiple approaches to material" project, in which this work is included, will be to create a plastics exhibition which will feature the Perlov celluloid collection.

HOST SUPERVISOR: PAULA NABAIS

The Yellows and Oranges of Antoine Janot & Paul Gout

Organic dyes have been used for artworks such as textiles, for millennia, and have great artistic and historic value. They may provide clues to the understanding of the technology behind an artwork's production. The characterization of natural organic colorants in artworks is still a challenge to this day, and of the natural dyes used in cultural heritage, yellows are some of the most difficult to identify. Hence, the use of historically accurate reconstructions may provide us with a clue about the manufacture of dyed textiles.

To test this approach, in this project we propose the reproductions of the yellows and oranges using recipes from French master dyers of the 18th century, Antoine Janot and Paul Gout. They wrote treatises similarly entitled *Mémoires.*

HOST SUPERVISOR: SILVIA PEREIRA

1- Disclosing the tile production of the Portuguese Golgen Age Masters
Supervisor: Sílvia Pereira (LNEC), Lurdes Esteves (MNAz)

Location: The National Laboratory for Civil Engineering (LNEC) and at the National Tile Museum (MNAz), Lisbon, Portugal.

This work will involve the selection of a group of signed tile panels from a Master or group of Masters of the tile Portuguese Golden age (end of the 17th-beginning of the 18th century). A 3D digital twin of the panels will be produced through photogrammetry, techniques of digital image processing will be used to map the possible degradation of the panels. Chemical-mineralogical characterization (SEM-EDS, XRF, XRD) will be performed to obtain information regarding the raw materials used, production technology and possible causes of decay. This work will contribute to obtain a broader understanding of the production context during the Master's golden period of the Portuguese production and acquire information that help the conservation of such important works for the National cultural Heritage.

2 - Consolidation of glazed surfaces
Supervisor: Sílvia Pereira (LNEC)
Location: The National Laboratory for Civil Engineering (LNEC), Lisbon, Portugal.

Glazed ceramics tiles are composite materials constituted by an impermeable glaze layer and a generally porous ceramic base. A new methodology of insitu consolidation will aim to conserve the fissured glaze layer via applying directly applying the consolidant on the decayed glaze surface. Several consolidants and impregnation techniques will be studied in a technique that has the potential to highly solve one of the main decay factors of the glazed tiles - the loss of its glaze layer which olds the tile artistic value. Techniques such as vapour and water absorption measurement, mechanical strength, micro-drilling, SEM-EDS, accelerated ageing will be used to access the effectiveness of the consolidation treatments.

HOST SUPERVISOR: TIM DE KOCK
UNIBO SUPERVISOR: ALESSANDRA BONAZZA

Black Crusts as Geochemical Archives: Reconstructing Urban Anthropogenic Pollution
Interaction between the historical built environment and environmental pollution can result in the accumulation of weathering crust. A subgroup of weathering crust is black crust, which consists of gypsum layers formed on calcium-rich substrates by sulfation. Black crusts can act as non-selective passive samplers, accumulating distinct layers of air contaminants associated with historical pollution levels. This thesis project will focus on the stratigraphic analysis of black crusts to assess their potential as a reliable geochemical archive for the reconstruction of past anthropogenic pollution within urban settings. For the identification of past air pollution signatures, lead can serve as a useful tracer due to its isotopes, their presence is the result of different historical pollution sources. For lead isotope analysis, high-resolution laser ablation mass spectrometry will be used to distinguish between ^{206}Pb, ^{207}Pb and ^{208}Pb. This project aims to deepen the understanding of localized pollution levels in urban settings, allowing for the implementation of strategies to mitigate the impact on human health, local ecosystems, and biodiversity, to support urban planning and environmental conservation efforts.

HOST SUPERVISOR: DR. FEDERICA CAPPA
UNIBO SUPERVISOR: PROF. GIORGIA SCIUTTO

The role of copper and zinc in the formation, structure and degradation patterns of Iron-gall inks
Iron-gall inks (IGI) are one of the most diffuse ancient inks in antiquity, in almost every geographical area and especially in medieval times. In all the historical recipes at least three main components are mentioned: an oak-galls extract rich in polyphenols, an iron salt and an organic binder. Their presence on ancient manuscripts is often associated with severe degradation patterns related both to their acidity and to Fenton-like reactions causing the formation of highly reactive radical species. However, their preparation could include the use of inorganic and organic additives (pigments, colorants, sugars etc…). The aim of this project will be the study of metal-polyphenolic complexes of interest in the context of IGI studies: iron, copper and zinc tannates and "hybrid complexes" formed in the copresence of these ions. In particular, the program will be focused on the determination of differences in terms of structural features and ageing patterns in mock-up samples with non-invasive and micro-invasive approaches. The use of Raman spectroscopy and FT-IR will be eventually associated with Continues Wave Electron Paramagnetic Resonance.

HOST SUPERVISOR: DR. FEDERICA CAPPA
UNIBO SUPERVISOR: PROF. GIORGIA SCIUTTO

Iron-polyphenolic complexes occurring in Iron-gall inks: accessing the variability of structures and properties

Iron-gall inks (IGI) are one of the most diffuse ancient inks in antiquity, in almost every geographical area and especially in medieval times. In all the historical recipes at least three main components are mentioned: an oak-galls extract rich in polyphenols, an iron salt and an organic binder. Their presence on ancient manuscripts is often associated with severe degradation patterns related both to their acidity and to Fenton-like reactions causing the formation of highly reactive radical species. However, their preparation could include the use of inorganic and organic additives (pigments, colorants, sugars etc…). The aim of the project will be the study of iron-polyphenolic complexes prepared using as source of polyphenolic ligands several commercial tannin samples. In particular, the program will be focused on the determination of differences in terms of structural features and ageing patterns in mock-up samples with non-invasive and micro-invasive approaches. The use of Raman spectroscopy and FT-IR will be eventually associated with Continues Wave Electron Paramagnetic Resonance.

ANNEX 2 – APPLICATION FORM

UNIVERSITA' DI BOLOGNA	**MASTER DEGREE COURSE** **SCIENCE FOR THE CONSERVATION-RESTORATION OF CULTURAL HERITAGE**

1. General information						
Current family name		Gender	F		M	
First name						
Birth family name						
Date of birth						
Nationality		2nd nationality				
Country of residence		From (MM/YYYY)				

2. Research experience (if applicable)			
If any, please indicate the number of years/months of research activity since gaining your university degree			
Research project 1			
Full time		Part time	
Start date (MM/YYYY)		End date (MM/YYYY)	
Research project 2			
Full time		Part time	
Start date (MM/YYYY)		End date (MM/YYYY)	

Research project 3			
Full time		Part time	
Start date (MM/YYYY)		End date (MM/YYYY)	

3. English Language knowledge				
		Reading skills	Speaking skills	Writing skills
Mother Tongue				
Very good				
Good				
Weak				

4. Contact address			
Name			
PO Box (if applicable)			
Street Name and Number			
Post Code		Cedex (if applicable)	
Town/City			
Country name			
Telephone No		Fax No	
Email			

5. RESEARCH PROPOSALS: 1st , 2nd and 3rd Preference (make reference to the research proposal titles listed in ANNEX 1		
Country and University in which the candidate would like to undertake his/her internship		
1st Preference/Country	Research proposal	
2nd Preference/Country	Research proposal	
3rd Preference/Country	Research proposal	

6. Declaration by the candidate		
I hereby declare that the information in this form is correct.		
DATE OF SIGNATURE		
SIGNATURE OF CANDIDATE		