



Study Plan

School: School of Social Sciences

Degree: Master

Course: Archaeology and Environment (Erasmus Mundus-ARCHMAT) (cód. 455)

Specialization Sciences of Archaeological Materials

1st Year - 1st Semester

Specialization Sciences of Archaeological Materials

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
Mandatory Curricular Units					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
HIS10511M	Archaeology – Culture and Context	Archeology	3	Semester	78
HIS10512M	Methods and Techniques of Archaeological Excavation	Archeology	6	Semester	156
QUI10532M	Basic Aspects of Science applied to Archaeology and Cultural Heritage	Chemistry and Geology	9	Semester	234
HIS10510M	Megalithic Culture	Archeology	3	Semester	78
GEO10533M	Introduction to Archaeometry	Chemistry and Geology	6	Semester	156
QUI10534M	Theoretical, Practical and Field Seminars on Archaeometry Case Studies	Chemistry and Geology	6	Semester	156
HIS10535M	Research Thesis I	Archeology/Chemistry/Physics/Geology	6	Semester	78
HIS10509M	Digital Techniques for modelling and visualization of archaeological data	Archeology	3	Semester	78

1st Year - 2nd Semester

Specialization Sciences of Archaeological Materials

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
HIS10536M	Greek Archaeology	Archeology	4	Semester	104
QUI10537M	Advanced Scientific Methods in Archaeometry	Chemistry/Physics	6	Semester	156
QUI10538M	Preventive Conservation of Archaeological Sites	Chemistry/Archeology	6	Semester	156
QUI10539M	Theoretical, Practical and Field Seminars on Archaeometry Case Studies I	Chemistry/Physics/Geology	6	Semester	130
QUI10540M	Archmat Summer School	Chemistry/Physics/Geology	6	Semester	104
HIS10541M	Introduction to Thesis II	Archeology/Chemistry/Physics/Geology	6	Semester	130

2nd Year - 3rd Semester

Specialization Sciences of Archaeological Materials

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
HIS10542M	Methods and Techniques of Archaeological Research	Archeology	5	Semester	130



**2nd Year - 3rd Semester
Specialization Sciences of Archaeological Materials**

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI10543M	Laboratory of Archaeometry	Chemistry/Physics/Geology	5	Semester	130
QUI10544M	Advanced Chemical Methods in Archaeological Materials Science	Chemistry	5	Semester	130
QUI10545M	Theoretical, Pratical and Field Seminars on Archaeometry Case Studies II	Chemistry/Physics	5	Semester	130
FIS10546M	Archaeometry: Dating Methods and Statistical Data Processing	Physics/Archeology	5	Semester	130
HIS10547M	Introduction to Thesis III	Archeology/Chemistry/Physics/Geology	5	Semester	130

**2nd Year - 4th Semester
Specialization Sciences of Archaeological Materials**

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
	Dissertation				

Conditions for obtaining the Degree:

*** TRANSLATE ME: Para aprovação na componente curricular é necessário a aprovação (através de avaliação ou creditação) das seguintes unidades curriculares:

1º Semestre: { \ }newline
5 a 7 UC obrigatórias num total de 27 Ects
2º Semestre: { \ }newline
5 UC obrigatórias num total de 25 Ects
3º Semestre { \ }newline
5 UC obrigatórias num total de 25 Ects

Para obtenção do grau, é necessário também a aprovação na Dissertação ou Relatório de Estágio, com um total de 43 ECTS. ***

Conditions for obtaining the Degree:

*** TRANSLATE ME: Para aprovação na componente curricular é necessário a aprovação (através de avaliação ou creditação) das seguintes unidades curriculares:

1º Semestre: { \ }newline
6 a 7 UC obrigatórias num total de 30 Ects
2º Semestre: { \ }newline
6 UC obrigatórias num total de 30 Ects
3º Semestre { \ }newline
6 UC obrigatórias num total de 30 Ects

Para obtenção do grau, é necessário também a aprovação na Dissertação ou Relatório de Estágio, com um total de 30 ECTS. ***

Program Contents

[Back](#)

Archaeology – Culture and Context (HIS10511M)

The telltale traces of human activity over time:

1. Prehistory old;
2. Prehistory recent;
3. Protohistory;
4. Roman period;
5. Medieval and modern period;
6. Contemporary period.



[Back](#)

Methods and Techniques of Archaeological Excavation (HIS10512M)

The different types of excavation: excavation of the survey area;
Excavations / polls minimization;
The Drawing Field;
Reports: text, maps, photographs, drawings, field
The scientific articles

[Back](#)

Basic Aspects of Science applied to Archaeology and Cultural Heritage (QUI10532M)

1. Introduction
 - 1.1 Basic concepts of chemistry and physics
 - 1.1.1 Structure of matter: Atoms and molecules; chemical nomenclature and formulas.
 - 1.1.2 State and properties of the matter.
 - 1.1.3 The composition of materials: major, minor and trace elements.
 - 1.1.4 Electromagnetic radiation; light: its nature and properties.
 - 1.1.5 Dating archaeological materials.
 2. Archaeological materials
 - 2.1 Structural materials
 - 2.1.1 Rock based materials- chemical and mineralogical composition
 - 2.1.2 Lithics, rocks and stones- identification of materials used
 - 2.1.2 Clay and fired materials- structural clay materials and ceramics
 - 2.1.3 Mortars and cements
 - 2.2. Pigments
 - 2.3 Sand and glass making
 - 2.4 . Gemstones- Common mineral species and varieties used as gems in antiquity
 - 2.5 Ores and Metals
 - 2.6 Organic materials – nature and chemical composition

[Back](#)

Megalithic Culture (HIS10510M)

1. The Megalithism
Megalithism and monumentality.
Megalithism and symbolic behavior.
 1. The emergence and evolution of megaliths: the different explanatory models.
 2. The megalithic funerary not.
The different types of monuments.
The interpretative models.
3. The megalithic burial.
The Portuguese case: its diversity.
The megalithic burial in southern Portugal.



[Back](#)

Introduction to Archaeometry (GEO10533M)

Principles of Archaeometric Analysis:

Destructive, microdestructive, non destructive archaeometric analysis, sampling procedures, sample preparation, analytical accuracy, precision, resolution and sensitivity. Provenance of raw materials, dating, identification of production techniques and centers, identification of commercial routes in the Antiquity; Identification of fakes and forgeries.

Diagnostic Techniques used for Chemical and Mineralogical analysis of Archaeomaterials. Basic Principles of light, electrons, protons, X-rays, interaction with matter. Optical and Scanning Electron Microscopy combined with microanalysis ; X-ray Diffraction ; X-ray Fluorescence Spectroscopy; Fourier Transform Infrared Spectroscopy ; micro-Raman Spectroscopy; Liquid and Gas Chromatography Mass Spectrometry. Differential Thermal Analysis and Thermogravimetric Analysis.

Diagnostic techniques used for Dating archaeomaterials: Thermoluminescence; Isotopic Techniques: ¹⁴C, Amino-acid racemization.

[Back](#)

Theoretical, Practical and Field Seminars on Archaeometry Case Studies (QUI10534M)

Possible case studies used in the classes:

- Exploitation of mineral and rock raw materials by ancient people.
- The mineralogy and geochemistry of clays and the provenance of ceramics.
- The chemistry, corrosion and provenance of ancient glass.
- Ore deposits, trade and use of metals.
- The analysis of human bone: diet, nutrition, and mobility.
- The analysis, trade and use of resinous substances.
- The detection of small biomolecules and identification of human diet.

[Back](#)

Research Thesis I (HIS10535M)

Bibliographic search:., evaluate the credibility of bibliographical sources, use information technology to carry out literature searches, databases creation of bibliographic searches.

Laboratory work schedule -experimental design with the objective of obtaining statistically relevant data. The ethical aspects of conducting scientific research.

Preparation reports based on scientific findings. Ethical issues related to the preparation of the dissertation / internship report and scientific articles in peer review journals.

[Back](#)

Digital Techniques for modelling and visualization of archaeological data (HIS10509M)

Introduction to Computers applied to archeology.

Components and features of different types of programs;

Adobe - Photoshop CS;

Adobe - Illustrator CS;

Corel



[Back](#)

Greek Archaeology (HIS10536M)

This Study Unit aims:

1. to provide students with an overview of the Greek history of art and architecture. Emphasis will be given to building construction and materials, and remnants of monumental art such as wall paintings or mosaics; as well as to movable artefacts. The techniques used through the centuries for creating works of art will be elucidated, while artistic production will be placed in its socio-historical and geographic context, emphasizing cultural influences and changes;
2. to provide students with an overview of field archaeology including land surveys to identify archaeological sites. Provide an overview of the excavation methodologies on land and in the sea with emphasis on the characterization of the different sediments and soils in which archaeological materials are found and the microclimate before and after excavation.

[Back](#)

Advanced Scientific Methods in Archaeometry (QUI10537M)

Inorganic materials

Nature and behaviour of stones and mortars.

Physicochemical characteristics of glass, glazes, faience and ceramics.

Properties of metals and metal artefacts. Methods of mining, extraction, metallurgical principles discussed in a chronological order.

Organic materials

Traditional and modern fibres and different types of wood.

Techniques of textile production. Different methods of paper, parchment and leather manufacture.

Overview of traditional techniques and materials used for painting and polychrome sculpture, of painting on canvas and wood.

Characterization of Materials

Review of the principles and applications of several optical methods of examination and analysis like optical and electronic microscopy.

Review of the principles and applications of several spectrometric methods of examination and analysis like ultra violet-visible and infrared spectroscopy, Raman spectroscopy, EPR and NMR spectroscopy.

[Back](#)

Preventive Conservation of Archaeological Sites (QUI10538M)

Major natural risks, such as earthquake destruction in archaeological sites will be discussed. It aims further at introducing the mechanisms and phenomenology of biodeterioration on organic and inorganic artefacts. The effects of the environment on various metals and metal alloys will be discussed.

The various aspects of preventive archaeology of sites and monuments will be addressed. Security and disaster management will also be covered.

Different aspects of preventive conservation of museum environments, display and storage areas, will be discussed. Security and disaster management will also be covered.

Various stabilisation techniques used in artefacts that are suffering from active forms of alteration will be discussed. The cleaning materials and methods commonly employed on artistic, historic and archaeological artefacts are presented. The materials and methods used for consolidation, adhesion and protection of de-cohesive and flaking porous artefacts are discussed.



[Back](#)

Theoretical, Pratical and Field Seminars on Archaeometry Case Studies I (QUI10539M)

Module 1: a) 1.Fundamentals of laser and materials interaction b) 2.- Laser cleaning, Different processes induced by a pulsed laser in a material. c) Case studies of laser cleaning in cultural heritage: case studies : Metals, Stone, Painting,
Module 2: a) X-Ray Fluorescence and applications Fundamentals of the technique;. Range of applications. Resolution; Sample Preparation; Interpretation of results b) Mass spectrometry and applications. Types of spectrometers. Areas of application. Preparation and injection of samples. Laser Ablation. Establishment of the method. Interferences. Interpretation of results

[Back](#)

Archmat Summer School (QUI10540M)

The ARCHMAT Summer School schedule will be as follows

1. Series of Theoretical and Practical Seminars on various case studies of advanced analytical techniques applied to the study and investigation of archaeological Materials. Each Summer School will be focused on a particular Archaeomaterial: glass, stone, mortar, ceramics, pigments.
2. Field trips to important archaeological sites and Museums Scientific laboratories in the country hosting that edition of the Summer School (Portugal, Greece, Italy, Morocco, France, Spain; Brasil).

[Back](#)

Introduction to Thesis II (HIS10541M)

The course will be delivered through workshops and seminars focusing on the following topics

Spoken and Written English in Conservation/Cultural Heritage/Archaeological Science research areas: scientific articles and conference settings
Spoken and Written English in Physical Science research areas: scientific articles and conference settings
Acquiring skills in oral and poster presentation using Scientific English in Conservation/Archaeology research area
Writing a Archaeometric scientific project in Scientific English

[Back](#)

Methods and Techniques of Archaeological Research (HIS10542M)

1. The phases of archaeological research, with hints of the history of research.
2. The methods of archaeological survey: aerial photo, geophysical methods, survey.
3. Mapping and documentation in the various phases of research.
4. Stratigraphy and techniques of excavation, with reference to the various types of intervention: multi-layered sites, cemeteries, underwater discoveries.
5. Sampling strategies.
6. Scientific methods applied to the study of the past human and natural contexts. Historical reconstruction.
7. Conservation and protection of the archaeological heritage.

[Back](#)

Laboratory of Archaeometry (QUI10543M)

Introduction to the course.

Palaeoenvironmental and palaeoclimatic reconstructions

Laboratory sessions on:

- Metallurgy.
- Lithic materials
- Ceramics
- Geophysical prospecting
- Identification of organic residues
- Inferring prehistoric diet: isotopic approaches



[Back](#)

Advanced Chemical Methods in Archaeological Materials Science (QUI10544M)

The program focuses on understanding Cultural Heritage through the study of the structure and properties of materials associated with human activities. Sampling and microanalysis methodology applied to cultural materials for study of their morphology, microstructure, and composition by applying in vitro optical, chemical, and instrumental methods. Topics include X-ray and electron spectroscopy, X-ray diffraction, infrared spectroscopy, chemical spot tests, and chromatography. Hands-on experience through object-based problem-solving approach. Practical skills acquired on sampling and sample preparation methods of cultural materials and on analysis of microsamples using basic instruments for characterization of organic and inorganic compounds. Processes of extraction, alloying, surface patination, corrosion, and microstructure of historic metals. Phase and stability diagrams of common alloying systems and analytical techniques appropriate for characterization of metallic artifacts

[Back](#)

Theoretical, Practical and Field Seminars on Archaeometry Case Studies II (QUI10545M)

Module 1: a) 1. Fundamentals of laser and materials interaction b) 2.- Laser cleaning, Different processes induced by a pulsed laser in a material. c) Case studies of laser cleaning in cultural heritage: case studies : Metals, Stone, Painting,

Module 2: a) X-Ray Fluorescence and applications Fundamentals of the technique;. Range of applications. Resolution; Sample Preparation; Interpretation of results b) Mass spectrometry and applications. Types of spectrometers. Areas of application. Preparation and injection of samples. Laser Ablation. Establishment of the method. Interferences. Interpretation of results

[Back](#)

Archaeometry: Dating Methods and Statistical Data Processing (FIS10546M)

The relationship of archaeometry to archaeology in the World.

Radiocarbon dating: history, principles, collection of samples, and measurement by beta decay-counting.

Radiocarbon dating by accelerator mass spectrometry (AMS).

Dendrochronology and calibration of radiocarbon dates.

Working with radiocarbon dates; interlaboratory calibration.

Radiometric dating of older materials (K/Ar, Ar/Ar, fission tracks).

Uranium series dating, electron spin resonance dating, thermoluminescence.

Archaeomagnetic dating; other dating methods.

Inferring prehistoric diet: chemical approaches.

Inferring prehistoric diet: isotopic approaches.

Archaeological and archaeometric data and their uncertainty

Random variables and their distributions

Basic methods of statistical data analysis

Dependence of distribute variable and correlation

Analysis of Variance

Regression and correlation

Basic methods of multivariate analysis

Cluster analysis

Principal Component Analysis

[Back](#)

Introduction to Thesis III (HIS10547M)

After successful completion of the syllabus of this unit the students will have acquired the comprehensive knowledge and skills required to draft in detail all stages of their thesis proposal with relevant timeline, deliverable and milestone and therefore be in the position to start and successfully carry out all phases of their thesis project in the following and last semester of their ARCHMAT Erasmus Mundus Masters Course. The same skills and competences on research project drafting will prove extremely useful also in their future quest for employment opportunities whether in the academic (PhD) and/or professional sectors