



Study Plan

School: Institute for Research and Advanced Training
Degree: Master
Course: Archaeological Materials Science (ARCHMAT) (cód. 689)

1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO13480M	Introduction to Archaeometry	Geology Chemistry	12	Semester	312
HIS13481M	Megalithic Culture	Archeology	6	Semester	156
QUI13483M	Digital Techniques and Laboratory Practice in Archaeological Materials Science	Archeology Chemistry	6	Semester	156
Group of Options					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI13479M	Basic Aspects of Science applied to Archaeometry	Geology Chemistry	6	Semester	156
HIS13482M	Excavation Methods, Culture and Contexts in Archaeology	Archeology	6	Semester	156

1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI13487M	Advanced Scientific Methods in Archaeometry	Physics Chemistry	9	Semester	234
GEO13485M	ARCHMAT Summer School	Geology Chemistry	6	Semester	156
GEO13486M	PREVENTIVE CONSERVATION OF ARCHAEOLOGICAL SITES	Physics Geology	6	Semester	156
GEO13484M	Greek Archaeology	Archeology Geology	6	Semester	156
QUI13488M	LINGUISTIC SKILLS APPLIED TO ARCHAEOLOGY	Geology Chemistry	3	Semester	78

2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI13489M	ENVIRONMENTAL AND EXPERIMENTAL ARCHAEOLOGY	Archeology Biological Sciences	9	Semester	234
QUI13490M	BIOLOGICAL AND PHYSICAL METHODS IN ARCHAEOLOGICAL MATERIALS SCIENCE	Biological Sciences Physics	9	Semester	234
HIS13493M	ROMAN ARCHAEOLOGY	Archeology	6	Semester	156
Group of Options					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO13494M	SMART MATERIALS FOR CONSERVATION IN ARCHAEOLOGY	Geology Chemistry	6	Semester	156
QUI13495M	HUMAN BIOARCHAEOLOGY	Archeology Biological Sciences Geology	6	Semester	156
QUI13496M	GIS AND STATISTICAL TOOLS IN ARCHAEOLOGICAL SCIENCES	Archeology Environment and Ecology Sciences	6	Semester	156



2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI13488M	* LINGUISTIC SKILLS APPLIED TO ARCHAEOLOGY	Geology Chemistry	3	Semester	78

2nd Year - 4th Semester

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:

1.º Ano

1.º Semestre:

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6 UC obrigatórias num total de 24 Ects

1 UC optativa do grupo de optativas do 1.º semestre num total de 6 ECTS

2.º Semestre:

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5 UC obrigatórias num total de 30 Ects

2.º Ano

3.º Semestre

{ \ }newline

3 UC obrigatórias num total de 24 Ects

1 UC optativa do grupo de optativas do 3.º semestre num total de 6 ECTS

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

Program Contents

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Introduction to Archaeometry (GEO13480M)

Principles of Geochemical analyses of materials: major, minor and trace elements. Provenance of raw materials, identification of production techniques, identification of commercial routes in the Antiquity; Identification of fakes and forgeries. Introduction to statistical data treatment. Optical and Scanning Electron Microscopy combined with microanalysis (OM, SEM+EDS); X-ray Diffraction (XRD); X-ray Fluorescence Spectroscopy (XRF); Fourier Transform Infrared Spectroscopy (FT-IR); micro-Raman Spectroscopy; Liquid and Gas Chromatography Mass Mass Spectrometry (LC-GC-MS); Differential Thermal Analysis and Thermogravimetric Analysis (DTA-TG); Laser Ablation Inductively Coupled Plasma Spectroscopy.

Inorganic archaeomaterials. Ceramics and pottery. Lithics and ornamental stones -Mortars and cements. Inorganic Pigments. Sand and glass making. Gemstones.

Organic archaeomaterials – Wood, textiles, paper, plastics. Organic residues. Bones. Dyes & pigments. Resins.



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Megalithic Culture (HIS13481M)

1. The Megalithism
 - Megalithism and monumentality.
 - Megalithism and symbolic behavior.
2. The emergence and evolution of megalithism: the different explanatory models.
3. Non-funeral megalithism.
 - The different types of monuments.
 - The interpretative models.
4. The funerary megalithism.
 - The different types of monuments.
 - The interpretative models.
5. Megalithism in the world
 - The different types of monuments.
 - The interpretative models.

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Digital Techniques and Laboratory Practice in Archaeological Materials Science (QUI13483M)

- Introduction to IT techniques applied to archeology and the study of Cultural Heritage objects.
- Introduction to Geophysical Survey, Remote Sensing, Structure from Motion Photogrammetry, Image Processing software, 3D scanning, Macrophotography, Microscopy. Data presentation and visualisation tools (3D viewers AR/VR; 3D printing).
- Introduction to Virtual Archaeology in Museum exhibitions.
- Practical Laboratory classes in innovative imaging and chemical analytical techniques applied to Cultural Heritage and Archaeometry. Students will be involved in currently running research projects and in the analysis of archaeological materials gaining first-hand preliminary experience in sample preparation and running of SEM+EDS, Raman Spectroscopy, LA-ICP-MS, IRMS, FT-IR Spectroscopy, XRF, micro-biological analysis.

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Basic Aspects of Science applied to Archaeometry (QUI13479M)

- Basic concepts of chemistry and biochemistry: Atoms and molecules; chemical nomenclature and states. Atomic Orbitals. Electronic configuration. Elements, compounds and mixtures: classification of matter. Chemical equilibria and bonding. Introduction to Periodic Table of elements. Chemical reactions: Acid/base, Redox reactions. Introduction to chemical kinetics. Principles of organic chemistry. Proteins and Carbohydrates. Fermentation Processes.
- Basic concepts of Physics. Physical properties of matter. Electromagnetic radiation; light, UV, IR, X-rays: nature and properties. Anthropogenic or natural radioactivity as archaeological signature and/or clock.
- Basic Concepts of Geology: the rock cycle. Igneous, Metamorphic and Sedimentary Rocks. Basic Principles of petrography and mineralogy.

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Excavation Methods, Culture and Contexts in Archaeology (HIS13482M)

- 1) The different excavation methods in archeology;
- 2) The archaeological record (drawing, photographs, 3D surveys);
- 3) Material processing in the laboratory;
- 4) Report Writing;
- 5) The revealing traits of human activity over time;
- 6) Scientific articles



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Advanced Scientific Methods in Archaeometry (QUI13487M)

The module on Analytical Chemistry Applications aims at providing students with a detailed overview of different methods and analytical techniques used for scientific investigation applied to archaeological area, i.e. high-performance liquid chromatography, liquid chromatography/mass spectrometry. It discusses the nature of the analysis, the level of the analytical work, the results obtained and their interpretation. The students are also be introduced to basic sample preparation.

The module on Properties of Materials aims at providing students with a detailed overview of the physical properties of parchment and leather; ceramics and faience; ores, metals and alloys; textile or paper fibres; and constituent materials in paint films – colouring materials and binding media. Lectures on Characterisation of Materials aim at providing students with a detailed overview of the principles and applications of ultra violet-visible and infrared spectroscopy, nuclear magnetic resonance and EPS.

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ARCHMAT Summer School (GEO13485M)

The module "Technical field visits" will be organised with the participation of the whole consortium. Technical visits will include visits to archaeological sites, museums, and research centres. The unit aims at acquainting students with the methodologies and techniques used in Archaeometry and Conservation Science, while taking into account the newest updates in the field, and at conducting them in applying this knowledge and these competences in their specific field of interest.

The module "Thematic seminars" will be organised by focusing on a specific topic for each edition of the ARCHMAT EMJMD and will see the participation of leading invited scholars from and outside the ARCHMAT Consortium. The unit aims at acquainting students with new methodologies and techniques used in conservation science and management of archaeological sites and provide students with an overview of current cutting-edge research in the field of Archaeometry and Conservation Science.

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PREVENTIVE CONSERVATION OF ARCHAEOLOGICAL SITES (GEO13486M)

The unit on Management of Risks aims at providing students with an overview of major natural risks, such as earthquakes in archaeological sites, and their assessment. In addition, the unit introduces the distinctive environmental parameters that affect artistic and historic artefacts, as well as the mechanisms and phenomenology of biodeterioration of composite systems (such as paintings, manuscripts and textiles), and the effects caused by the different behaviour of materials in such systems. The unit on Preventive Conservation aims deals with active and passive environmental control and monitoring of critical parameters in open-air situations, including preventive control in archaeological areas. The unit further deals with the various aspects of preventive conservation of museum environments. Finally, students are acquainted with the principles and application of optical microscopy in the examination of environmentally affected artefacts.

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Greek Archaeology (GEO13484M)

Module History of Arts and Techniques; overview of the history of art/architecture and techniques from prehistory to recent times with emphasis to Greek building systems and materials, monumental art, such as wall paintings or mosaics; as well as to movable artefacts, for example sculptures, paintings, textiles and manuscripts. The techniques used through the centuries for creating works of art are elucidated in their general aspects, while artistic production is placed in its socio-historical and geographic context. Module Geoarchaeology aims at providing students with an overview of field archaeology including land surveys to identify archaeological sites, as well as the methodology and procedures of excavation. It further introduces an overview of the methods of excavation on land and in the sea with emphasis on the characterisation of the different sediments and soils, in which archaeological materials are found, and the microclimate before and after excavation.



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LINGUISTIC SKILLS APPLIED TO ARCHAEOOMETRY (QUI13488M)

Based on the project Languages for Specific Purposes- Cultural Heritage developed at the AUTH partner, the course takes learners from a low B2 to a high B2 level of language competence. There are six units in all, each unit covering a particular conservation science and cultural heritage topic. All six units are of equal difficulty and learners can pick and choose the topics and activities, as and when they wish, from anywhere in the manual. Units contain activities to develop the four communication skills – Reading, Listening, Speaking and Writing – together with Language Focus Activities intended to especially reinforce, develop and expand those lexical points, which are specific to the conservation science field. A certain number of grammatical points are featured in some of the units. The recordings are on a CD which is provided with the Learner's/Student's Manual.

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ENVIRONMENTAL AND EXPERIMENTAL ARCHAEOLOGY (QUI13489M)

Module 1

Introduction to Environmental Archaeology

- Principles of pollen analysis. Interpretation of pollen records. Reconstruction of past flora, vegetation, climate, and environment
- Palaeoecology and palaeoclimate
- Human impact on past natural landscape. The transition from wild to domesticated plants: age and geographical distribution of the earliest remains of cereals, pulses, fruit trees and nuts, oil- and fibre-producing crops, ornamental plants, spices
- Ancient DNA
- Sampling from archaeological contexts: planning and execution (6 h)
- Pollen Laboratory processing. Pollen identification

Module2

- Fundaments of experimental archaeology, technological, use-wear, residues analyses{\}
- experimental sessions for reproducing replicas to be observed and discussed through the observation with optical and digital equipment
- Basic knowledge of the use of OLM and SEM for technological, use-wear and residues analyses



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BIOLOGICAL AND PHYSICAL METHODS IN ARCHAEOLOGICAL MATERIALS SCIENCE (QUI13490M)

Biological Unit

Fossil remains: etymology and definition

Macrofossils and microfossils

Conditions for preservation of plant and animal remains

Different types of plant and animal remains

Identification of fossil woods

Laboratory work on phytoliths

Laboratory work on cuticles

Seeds and fruits from archaeological sites

Diatoms and other siliceous remains

Faunal remains

Plant and animal fibres

Physical Unit

Fundamentals of Solid-State Physics and Light-Matter Interaction

Optical microscopy, imaging, 3D laser scanning and structured illumination imaging

Optical spectroscopy, UV/VIS, photometry and colorimetry

Multispectral Imaging in Reflectance and Photo-induced Luminescence modes

Vibrational spectroscopy, Raman and IR

X-Ray fluorescence

X-Ray diffraction

X-ray tomography

Atomic-force microscopy

Electronic microscopy, scanning and transmission

Radiocarbon dating

Isotope analysis, tracking and provenance (2 h)

Thermoluminescence

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ROMAN ARCHAEOLOGY (HIS13493M)

- Introduction and historical background, evolution of Roman culture

- buildings and monuments, including temples, baths, fora, and the related decoration and sculpture

- Cities and monuments in Italy and in the whole Roman Empire, extending to the

Mediterranean and to some European countries

- modern techniques applied to Roman archaeology



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SMART MATERIALS FOR CONSERVATION IN ARCHAEOLOGY (GEO13494M)

Unit Geomaterials

- Definitions and production technology of ceramic material focusing on bricks and building material. Alteration processes and related problems in conservation.
- Definition and origin of stone material used in the field of cultural heritage. Main techniques of extraction and surface treatments. Alteration processes and related conservative problems. Definition and different painted surfaces with related alteration problems.
- Definition and technology production of glass. Conservation problems related to the different alteration processes.

Unit Smart Materials

- Definition and production of metals and alteration processes
- Definition and production methods of mortars and plasters. Alteration and conservation problems.
- Smart materials for the cleaning of painted surfaces
- Smart materials for the consolidation of stone surfaces
- Smart materials for autocleaning, antifouling and antimicrobial behaviour of the surfaces
- Smart materials as detection sensors

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HUMAN BIOARCHAEOLOGY (QUI13495M)

Introduction to evolutionary biology. Comparative morphology and anthropometry. Systematics, variability and ecology of non-human primates. Taphonomy and formation of paleontological deposits; Palaeolithic archeology. Elements of anthropological anatomy (cranium, teeth, postcranial bones). Growth and skeletal development. Morphology and morphometry- Techniques and methods of data analysis. Contribution and new data of paleogenetics. The main trends in human evolution. Phylogeny of the genus Homo. Origin, diffusion and present variability of Homo sapiens. Bio-cultural interaction between humans and the environment. Study-cases.

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GIS AND STATISTICAL TOOLS IN ARCHAEOLOGICAL SCIENCES (QUI13496M)

Unit 1

Introduction to Geographical information System. Thematic cartography models and examples of the representation of discrete and continuous phenomena.

Hardware and Software. Computers, scanners, plotters. Open source and commercial GIS.

Digital geographic data: vector and raster data. Attributes and databases. The Geodatabase. Design of a database. Cataloging and metadata.

Geo-referencing. Datum, coordinate systems and cartographic projections.

Data acquisition. Airborne and satellite remote sensing. Global Positioning System.

Data analysis. Spatial and attribute analysis.

Representation of data. Charts. Symbologies and Layout

Unit 2

Measurement levels and graphical summaries of numerical variables

Descriptive statistics and numerical summaries of single variables

Statistical inference, measures of association, the chi-squared and Kolmogorov-Smirnov tests, Normal and t distributions, confidence intervals and sampling

Statistics in archaeology: Applications and case studies