UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Fisica e Chimica - Emilio Segrè
ACADEMIC YEAR	2021/2022
MASTER'S DEGREE (MSC)	CULTURAL HERITAGE CONSERVATION AND RESTORATION
INTEGRATED COURSE	CHEMISTRY OF RESTORATION - INTEGRATED COURSE
CODE	01844
MODULES	Yes
NUMBER OF MODULES	2
SCIENTIFIC SECTOR(S)	CHIM/02, CHIM/12
HEAD PROFESSOR(S)	LAZZARA GIUSEPPE — Professore Ordinario — Univ. di PALERMO
OTHER PROFESSOR(S)	LAZZARA GIUSEPPE — Professore Ordinario — Univ. di PALERMO MURATORE NICOLA — Ricercatore — Univ. di PALERMO
CREDITS	12
PROPAEDEUTICAL SUBJECTS	01900 - GENERAL AND INORGANIC CHEMISTRY
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	Annual
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**LAZZARA GIUSEPPE** Monday 11:00 12:00 studio del prof. Giuseppe Lazzara (1/B16) viale delle scienze pad. 17 Wednesday 11:00 12:00 studio del prof. Giuseppe Lazzara (1/B16) viale delle scienze pad. 17 **MURATORE NICOLA** Monday 14:30 15:30 Stanza 0/A6 - Dipartimento di Fisica e Chimica - Ed. 17 - Viale delle Scienze Wednesday 14:30 15:30 Stanza 0/A6 - Dipartimento di Fisica e Chimica - Ed. 17 - Viale delle Scienze Friday 14:30 15:30 Stanza 0/A6 - Dipartimento di Fisica e Chimica - Ed. 17 - Viale delle Scienze

DOCENTE: Prof. GIUSEPPE LAZZARA

PREREQUISITES	Each student has to be acquired the knowledge of the concepts provided in the course of General and Inorganic Chemistry. In such a way, the student's attending to the course will be fruitful.
LEARNING OUTCOMES	KNOWLEDGE AND ABILITY OF COMPREHENSION The goal of the course aims at providing the basic concepts for the definition of the composition and chemical characteristics of the materials pertinent with the Cultural Heritage issue and adequate knowledge of the phenomena and the physico-chemical systems of interest in the restoration with particular attention to the interfacial phenomena and colloidal systems. The concepts will be developed in view of the interaction of materials and work of arts with the substances present in the environment in order to identify and define the degradation processes. In addition, students must acquire the tools to define the parameters characterizing the materials and substances they interact with and, if necessary, to propose solutions for the restoration. CAPACITY TO APPLY KNOWLEDGE AND COMPREHENSION Ability to define the main chemical characteristics of a material in terms of composition and reactivity. Knowledge of the peculiarities of colloidal systems applied to the Conservation and Restoration of Cultural Heritage and problems related to surface phenomena. MAKING JUDGMENTS Ability in identifying interactions between the materials and the different natural and anthropogenic substances present in the environment. Being able to identify the damage to materials, with particular reference to those anthropogenic and independently assess the implications and the potential application of colloidal systems during the stages of restoration and/or consolidation of art-work. ABILITY OF COMMUNICATION Being able to explain the basic concepts of the restoration chemistry and the nature of colloids and surface phenomena when required during the restoration process, integrating them with the concept of interaction with the environment. Being able to highlight the impact of technologies based on colloidal systems in the Cultural Heritage field. LEARNING CAPACITY Being able to explore topics through specific scientific articles of the matter and to follow seminars and insights as part of the restoration chemistry
ASSESSMENT METHODS	The evaluation of student learning requires the possession of the skills and knowledge of the subject matter of the course as well as the ability to apply them to problems related to the restoration of a Cultural Heritage. In addition, it verifies the possession of property of scientific language and of exposure capacity. The student assessment is performed through two semi-structured written tests, carried out without the help of textbooks or notes, and a short oral examination where the evaluation of the tests is presented. One test focuses on the topics of the Restoration Chemistry module while the other on those of the Physics Chemistry module. The evaluation of each test ranks between 18 and 30 cum laude. Therefore, the final evaluation of the overall course is given by the sum of the test evaluations that is divided by two. The student will pass the examination if he has at least the score of 18/30 in each test. Different ranking of final evaluation will be done as detailed in the following: 1) Basic knowledge of topics and limited capacity of processing knowledge and of correlation among the various topics for application to the issues of Conservation and Restoration of Cultural Heritage. Sufficient capacity analysis of the proposed phenomena. Sufficient judgment ability and exposure of the pursued procedure (rating 18-21) 2) Rather good knowledge of topics and good capacity of processing knowledge and of correlation among the various topics for application to the issues of Conservation and Restoration of Cultural Heritage. Rather good capacity of analysis of the proposed phenomena. Rather good judgment ability and exposure of the pursued procedure (rating 22-24) 3) Good knowledge of topics and ability in processing knowledge and of correlation among the various topics for application to Conservation and Restoration of Cultural Heritage. Good capacity of analysis of the proposed phenomena. Good judgment ability and exposure of the pursued procedure (rating 25-27) 4) Excellent knowledge of the topics, excellent and prompt capacity of knowledge processing and of correlation among the various topics for application to the issues of Conservation and Restoration of Cultural Heritage even to contests different from those proper of the course. Very good capacity of analysis of the proposed phenomena. Very good judgement ability and exposure of the pursued procedure (rating 28-30) 5) Excellent knowledge of the topics, excellent and very smart capacity of processing and of correlation among the various topics for application to the issues for Conservation and Restoration of Cultural Heritage even to contests

	different from those proper of the course. Excellent capacity of analysis of the presented phenomena. Excellent judgement ability and exposure of the pursued procedure (rating 30 cum laude)
TEACHING METHODS	The course is annual being that it is provided into the two periods of the second year; in particular, the Module "Chemistry of Restoration" and the module "Physical-Chemistry" are given held in the first and second semester, respectively. Only lectures are provided

MODULE
CHEMISTRY OF RESTORATION

Prof. GIUSEPPE LAZZARA

SUGGESTED BIBLIOGRAPHY

C. Campanella, A. Casoli, M.P. Colombini, R. Marini Bettolo, M. Matteini, L.M. Migneco, A. Montenero, L. Nodari, C. Piccioli, M. Plossi Zappala, G. Portalone, U. Russo, M.P. Sammartino, Chimica per l'Arte, Zanichelli (2007)
V. Di Marco, P. Pastore, G.G. Bombi, Chimica Analitica, Zanichelli (2015).
S. Glasstone, Trattato di Chimica Fisica, Manfredi Editore, I Edizione Italiana (1963)
P. C. Hiemenz, Principles of Colloid and Surface Chemistry, Marcel Dekker, III Edizione (1997).

AMBIT	50687-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48

EDUCATIONAL OBJECTIVES OF THE MODULE

The aim is at providing physico-chemical knowledge on the processes of degradation of materials, on the chemical nature of pictorial materials and on thermodynamics of interfaces as well as on phase diagrams in order to provide knowledge to be applied to the Cultural Heritage issue based on a scientific method. Such a scientific knowledge allows the student to study the artifact and to develop the interrelations between the constituent materials.

SYLLABUS

Hrs	Frontal teaching
1	Aims of the course.
3	Chemical reactivity and degradation processes.
3	Inorganic Pigments. Physico-chemical characterization of tempera. Pigments-binders interactions
2	Hydrolysis equilibria. Precipitation equilibria.
3	Redox equilibria, Equilibria of complex formation.
4	Phase diagrams of pure components and binary systems. Liquid/vapor phase diagram. Ideal and nonideal systems. Azeotrope. Distillation
2	Solid/liquid phase diagram for binary mixtures. Experimental method to determine the temperature vs composition diagram
4	Ternary systems. Gibbs Triangle.Teas solubility diagram. Parameters of solubility for polar and apolar solvents.
4	Large interphase systems and their role within the Cultural Heritage. Thermodynamic derivation of surface tension. Experimental methods for measuring surface tension.
3	Surface tension: effect of a solute addition. Adsorption isotherm of Gibbs
3	Thermodynamic treatment of the La Place equation. Capillarity. Kelvin equation for vapor tension.
2	Contact angle and wettability.
2	Young-La Place equation. Spreading Coefficient.
4	Colloidal systems and their stability
4	Classification of conventional and polymeric surfactants. Interfacial properties
3	Thermodynamics of surfactants aggregation and modelling.
1	Solid / liquid interphase. Langmuir adsorption isotherms

MODULE
PHYSICAL CHEMISTRY

Prof. NICOLA MURATORE

SUGGESTED BIBLIOGRAPHY

Elementi di Chimica Fisica, Atkins, Zanichelli (2007).
Elementi di Chimica. Chimica Fisica e Materiali per i Beni Culturali, Motta - Carotenuto - Alfano, CUES (2008).
La Diagnostica nei Beni Culturali. Moderni metodi di indagine, Paolillo - Giudicianni, Loghia (2009).
Chimica Analitica Strumentale, Skoog - Leary, EdiSES (1995).

AMBIT	50684-Scienze e tecnologie per la conservazione e il restauro
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48

EDUCATIONAL OBJECTIVES OF THE MODULE

The aim of the course is to provide the knowledge needed to understand the thermodynamic and kinetic properties of massive systems and to introduce in general terms the main techniques of chemical analysis. Such knowledge allows the student to develop the necessary scientific approach for solving conservative and restoring problems of cultural heritage artefact.

SYLLABUS

Hrs	Frontal teaching
1	Introduction and aim of the course.
3	Gas laws.
4	First principle of thermodynamics.
4	Enthalpy and heat capacity.
4	Second principle of thermodynamics.
4	Gibbs free energy function.
3	Thermodynamic criteria for equilibria.
3	Partial molar properties.
2	Phase rule.
4	Colligative properties of solutions.
3	Equilibrium constant.
4	Chemical kinetics and transport phenomena.
3	Radiation-matter interaction: hints.
2	Chemical analysis: the main non-destructive and destructive techniques.
2	Chemical analysis: sampling.
2	Chemical analysis: the main statistical parameters.