UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Fisica e Chimica - Emilio Segrè
ACADEMIC YEAR	2022/2023
MASTER'S DEGREE (MSC)	PHYSICS
SUBJECT	PHYSICAL CHEMISTRY OF MATERIALS
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	20901-Attività formative affini o integrative
CODE	15346
SCIENTIFIC SECTOR(S)	CHIM/02
HEAD PROFESSOR(S)	PIGNATARO BRUNO GIUSEPPE Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	88
COURSE ACTIVITY (Hrs)	62
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	PHYSICAL CHEMISTRY OF MATERIALS - Corso: CHEMISTRY PHYSICAL CHEMISTRY OF MATERIALS - Corso: CHIMICA
YEAR	2
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**PIGNATARO BRUNO GIUSEPPE** Tuesday 14:30 16:00 Il ricevimento si effettua presso lo studio del Prof. Pignataro (ed. 17 V.le delle Scienze). Il docente e' disponibile anche per appuntamento sulla piattaforma Teams concordando l'orario e il giorno via email a bruno.pignataro@unipa.it.

DOCENTE: Prof. BRUNO GIUSEPPE PIGNATARO

PREREQUISITES	The study of Physical Chemistry of Materials requires good knowledge of Matematics, General Chemistry, basic Physical-Chemistry disciplines (thermodynamics, spectroscopy, etc.) and Chemistry of Solid State
LEARNING OUTCOMES	1) Knowledge and ability to understand - Acquisition of the concepts of physical chemistry of materials - Capacity to apply knowledge and understanding - Acquisition of cultural tools necessary to undertake a research activity in the field of material science. Understanding of the literature. Capacity to design procedures of preparation and experimental measurements for the determination of the correlation structure-property of organic and inorganic materials, nanomaterials and their possible applications 2) Ability of judgment - Capacity to critically evaluate the results of the scientific literature 3) Ability to communicate - Capacity to communicate concisely and in an appropriate way the gained knowledge - Learning capacity - Ability to organize the acquisition of more knowledge in the field of physical chemistry of surfaces, interfaces, nanostructures, materials and devices
ASSESSMENT METHODS	It will be done an oral test consisting of an interview aimed at ascertaining the possession of skills and subject knowledge provided by the course. The assessment is expressed in thirtieths. Applications specifically designed to test the learning outcomes will tend to evaluate: a) the knowledge gained; b) the processing capacity; c) the possession of adequate presentation skills. As for the evaluation of knowledge, it will be considered the ability to correlate theory, experimental data and physical meaning. As regards the processing capacity, it will be considered the ability to synthesize, to distinguish the fundamental elements for the technological applications and to correlate the structure with the properties of materials and the performance of devices . As regards the presentation skills, a rating will be given for the student depending on the command of language. The final evaluation is graduated taking into account the following points: 1) Basic knowledge of the concepts of the physical chemistry of materials, with particular reference to basic knowledge of materials, surfaces or interfaces and related preparaction/characterization tools, property-structure correlations and the functioning of functional devices (grades 18-21); 2) Good knowledge of the lessons learned and discrete processing skills regarding the cases presented during the exam (vote 22-25); 3) In-depth knowledge of the lessons learned; processing capacity with high degree of autonomy for the cases proposed during the exam; good presentation skills (vote 26-28); 4) In-depth knowledge of theory and concepts taught in lesson; excellent processing capabilities to deal promptly and correctly with the proposed cases; excellent presentation capabilities (vote 29-30L).
EDUCATIONAL OBJECTIVES	The course constitutes an introduction to the physical chemistry of materials with particular reference to the structure and properties of solid state surfaces, thin films and nanostructured materials. The student will learn the basic concepts that can open a research activity in the areas related to the physical chemistry of materials with particular attention to the employment of the peculiar skills in the preparation, characterization and applications of materials and organic and inorganic nanomaterials. The objective of the course will be therefore to acquire knowledge about: • Preparation and characterization of surfaces, thin films and nanomaterials • The correlation structure - property - function in materials • Fundamental principles that govern the materials properties (optical, electronic, chemical, bio - chemical, etc . .) • Specific knowledge of some important classes of organic and inorganic materials and their applications
TEACHING METHODS	There will be done frontal lessons (4 CFU) and laboratory lessons (2 CFU).

	The lessons could be done in presence or at distance in dependence of the current provisions.
SUGGESTED BIBLIOGRAPHY	- L. Smart, E. Moore, Solid state chemistry, Stanley Tornes Ltd. 1995 - S.Elliott: The physics and chemistry of solids (J. Wiley) 1998 - J.I. Gersten, F.W. Smith: The physics and chemistry of materials 2001 - C. Kittel: Introduction to solid state physics 2004 - Adamson: Physical Chemistry of Surfaces 1997 - Appunti e materiale didattico fornito dal docente (Notes and didactic material provided by the teacher)

SYLLABUS

Hrs	Frontal teaching
4	The four forces in nature and interactions of atoms, molecules and ions; Interatomic and intermolecular forces and their origin; Bulk and surfaces of materials; Definition of surfaces and the thickness to be considered for the study of materials
6	Method to study Surfaces and Interfaces; Photoelectron spectroscopy as a technique for the study of the chemical composition of surfaces; Other radiative techniques for the characterization of solid surfaces.
2	Surface modification by gas or solutions; Surface coatings
4	Surfaces and Interfaces: Some applications; Preparation of molecular self-assembled monolayers and thin films
4	Relationship between Properties and Structure of materials: Generality; Examples: nuclear structure, elementary electronic structure, electronic structure of molecules and molecular or material shapes, general considerations on the importance of the molecular shape, electronic structure and intermolecular forces in relation to the properties and functions of chemical systems; Design of the molecular properties and functions
3	Organic, inorganic and hybrid nanomaterials: structure
3	Scanning Probe Microscopies; Other nanomaterials characterization techniques
3	Structure-properties relationship in nanomaterials; Optical, electronic, electric and chemical properties of nanomaterials
3	Specific applications: functional devices

Hrs	Workshops
8	Preparation of surfaces and functional nanomaterials
8	Spectroscopic characterization of nanomaterials and thin films
8	Realization of heterojunction devices
6	Characterization of optoelectronic properties of functional devices