Dottorato di Ricerca in Scienze Chimiche - Università degli Studi di Firenze

PROPOSTA DIDATTICA 2020

NO SSD (trasversale)

TITOLO DEL CORSO/COURSE TITLE: Making medicines available for treatment with Quality, Safety and Efficacy

DOCENTE: Dr.ssa Monica Bertocci (Quality Operations Manager – Internal Quality Assurance Manager, PharmaDes)

DOCENTE PROPONENTE: Prof.ssa Cristina Nativi

ABSTRACT:
- Medicinal products life cycle.
- Normative references (Development, production, distribution, safety)
- Marketing authorization
- Role and Responsibility of the Marketing Authorization Holder
- Pharmaceutical company organization : key roles
- Active Pharmaceutical Ingredient and Medicinal products production: EU and extra EU
- Active Pharmaceutical Ingredient and Medicinal products supply chain : EU/Extra EU
- Market feedback : complaints, adverse event/pharmacovigilance, market recall
- Outsourcing activities management

Periodo di Svolgimento/Time Schedule:
February-March 2020

Prova di accertamento/Final test: Learning test and/or discussion of real cases

SSD: CHIM/01-CHIM/02

TITOLO DEL CORSO/COURSE TITLE: Advanced Bio-Technological Applications of Nanostructured Materials

DOCENTE: Dr.ssa Patrizia Andreozzi

ABSTRACT: The aim of the course is to give an overview on the design and development of novel nanomaterials and their chemical-physical characterization, as well as the advanced applications of nanoscience. During the course different typologies of nanomaterials will be described focusing on their application as drug delivery systems, sensors and diagnostic probes for the study of nano-bio interactions. The goal of the course is to discuss the advanced applications of nanotechnologies by providing interdisciplinary scientific knowledge at the interface of chemistry, physics and biology. In this way, the students should acquire skills on the rational design of bio-functional nanomaterials

to solve biological problems.

Course Outline
The course contains the following topics:
Design and development of nanostructured materials (hard and soft nanomaterials).
2 hours
Physical-chemical characterization of nanostructured materials.
1 hour
Interaction of nanomaterials with biological systems (proteins, cells, viruses).
1 hour
Nanomaterials for bio-applications: drug and gene delivery.
1 hour
Nanostructured materials for biosensing applications.
1 hour
Advanced techniques for nanobiotechnology applications.
2 hours

Periodo di Svolgimento/Time Schedule:
13 July 2020 (14:30 – 16:30)
14 July 2020 (14:30 – 16:30)
15 July 2020 (14:30 – 16:30)
17 July 2020 (14:30 – 16:30)

Prova di accertamento/Final test: Critical reading and discussion of a scientific paper on the course topics

SSD: CHIM/02-CHIM/12

TITOLO DEL CORSO/COURSE TITLE: Introduction to rheology: fundamentals and applications

DOCENTE: Dr.ssa Giovanna Poggi

ABSTRACT: Rheology studies the deformation of matter resulting from the application of a force. The extent to which a material deforms under a certain force depends strongly on its properties. Even if unconsciously, we deal with rheology in our daily life: for instance, we commonly use the terms viscous, creamy, sticky, gelatinous, sticky, rigid, flexible, and elastic to define different materials. Therefore, we evaluate, even though empirically, the rheological properties of the matter. Many commercial products must have specific rheological properties to perform their action in an optimal way: shampoos must be slightly viscous so to be poured into the hands and then on the head, without flowing away easily. Moreover, toothpaste must be viscous enough to stay on top of the toothbrush, but it must also be fluid enough to come out of the tube after the application of a small pressure. Finally, the ink of a ballpoint pen must be liquid enough to flow away from the ball but not too much to the absorbed into the paper sheet.
Materials that contain two or more phases, such as gas particles in a foam, an emulsion of immiscible liquids or solid particles dispersed in a liquid, are considered structured fluids since their rheological behavior is mostly dominated by the interactions between different compounds.
The aim of this course is to introduce the fundamentals of rheology and to deepen some of its

applications, such as the study of colloidal systems and gels, so to provide insights on the potential use of rheological measurements for the characterization of a wide selection of materials.

Periodo di Svolgimento/Time Schedule:
March/April 2020

Prova di accertamento/Final test: Students will be asked to select an article on the rheological characterization of materials and to discuss it in front of the class

SSD: CHIM/02-CHIM/12

TITOLO DEL CORSO/COURSE TITLE: Nanostructured fluids for the cleaning of works of art – Development and Characterization

DOCENTE: Dr. Michele Baglioni

ABSTRACT: Nanostructured fluids, such as micellar solutions and microemulsions, are being specifically developed for the cleaning of artistic surfaces since the beginning of the 1990s. Their effectiveness was thoroughly demonstrated and the main aspects of the cleaning processes involved in their use have been unveiled. This class aims to give an overview on the main properties of surfactants, micelles, and microemulsions spanning from the basic physico-chemical concepts to their practical application in the field of conservation of cultural heritage. The main analytical techniques used to characterize colloidal systems will also be discussed. The topics of the class can be summarized as follows:
- Surfactants, micelles and microemulsions – some theory (properties of surfactants, classification, self-assembly, phase diagrams)
- Nanostructured fluids and art conservation – cleaning issues (degradation processes, materials, procedures,`state-of-the-art on cleaning)
- Analytical techniques for the characterization of nanostructured fluids (scattering techniques, i.e., SAXS, SANS, QELS, surface tension measurement, contact angle measurements, CLSM)
- Development and assessment of nanostructured fluids for the cleaning of artworks (formulation, characterization, laboratory tests on mockups, in situ tests on real works of art)

Periodo di Svolgimento/Time Schedule:
March/April 2020

Prova di accertamento/Final test: The students will have to read and discuss a scientific paper on the topics of the class

SSD: CHIM/03

TITOLO DEL CORSO/COURSE TITLE: Introduction to Python for scientist

DOCENTE: Dr. Giuseppe Cucinotta

ABSTRACT: For today scientists (and not only) the knowledge of a programming language is one of the most valuable skills. Python represents one of the most widespread program languages used

in very different fields including, just to name a few, mobile apps realization, web development, machine learning. In particular, this course intends to give an overview of the possibilities offered by Python to scientists and to provide the students with the basic instruments to start using Python for data analysis. No particular programming knowledge is requested to attend the lessons, indeed this course will at first introduce Python fundamentals including main built-in types (numbers, strings, lists), flow control tools (if… then… else statement, for and while loops) and functions. Following, principal scientific libraries (numpy, scipy, matplotlib) will be presented and how to use them to create arrays, make computations, plot and analyze data. Input/output methods to read and write data to files will also be explained.

Periodo di Svolgimento/Time Schedule:
June 2020

Prova di accertamento/Final test:
Assignment to be carried out by writing a Python program to be discussed with the teacher

SSD: CHIM/03

TITOLO DEL CORSO/COURSE TITLE: Anion Coordination Chemistry Fundamentals

DOCENTE: Dr. Matteo Savastano

ABSTRACT: Anion Coordination Chemistry has a delay in its development of about ¾ of a century in comparison to its twin, Cation Coordination Chemistry. Such a setback arises both from practical limitations and chemists' general mindset. This course aims at telling the story from the beginning, guiding students in understanding that there is more than a vertical bar distinguishing a positive from a negative species. Once such differences are understood, it is possible to re-examine supramolecular forces holding together anion complexes. Among them, some are rarely known and fully understood by students, as their discussion can be hardly accommodated in today's already dense curricula. Examples include anion-π interactions, halogen bonding and solvent effect on complexation phenomena. Being unfamiliar at best, recognition, assessment and quantification of such interactions is even less frequently discussed in academic courses, preventing full appreciation of the usefulness of these forces and perpetuating the false idea of Anion Coordination Chemistry as subordinate research field. This course intends to offer the basic tools required to join contemporary (and quite active) scientific discussion in this area.

Periodo di Svolgimento/Time Schedule:
September 2020

Prova di accertamento/Final test: Critical review and discussion of a scientific paper focusing on topics covered in the course

SSD: CHIM/03

TITOLO DEL CORSO/COURSE TITLE: NMR plug n' play: a practical guide to setup helpful experiments for chemical synthesis

DOCENTE: Dr. Damiano Cirri

ABSTRACT: The course will discuss several practical aspects of NMR spectroscopy, starting from sample preparation to experiment configuration, data acquisition and analysis. The main components of the NMR spectrometer will be briefly illustrated. Explanations about the basic experiments and the associated experimental parameters will be provided; simple proton decoupling sequences will be discussed. The course will include some practical demonstrations concerning the experiments that are most commonly used in the characterization of small organic and inorganic molecules. The importance of multinuclear NMR spectroscopy will be stressed.

Periodo di Svolgimento/Time Schedule:
July 2020

Prova di accertamento/Final test: Discussion of 1D and 2D spectra of a simple organic molecule

---

SSD: CHIM/03

TITOLO DEL CORSO/COURSE TITLE: Metal Complexes as Drugs and Chemotherapeutic Agents

DOCENTE: Dr. Lara Massai

ABSTRACT:
- brief overview of the physical and chemical properties of metal complexes
- metallo-drugs and their action; nature and structure of biological targets,
- illustration of the steps from drug discovery to marketplace
- focus on individual metallo-drugs, drug candidates and metal-containing agents used to treat and diagnose disease, their synthesis, structures and known mechanisms of action.

Periodo di Svolgimento/Time Schedule:
March/April 2020

Prova di accertamento/Final test: Oral presentation (five/six slides) on a paper related to the topics covered

---

SSD: CHIM/03

TITOLO DEL CORSO/COURSE TITLE: Orbital Interactions in Chemistry

DOCENTE: Prof. Federico Totti

ABSTRACT: The course will cover the construction of molecular orbital interactions through a perturbative theoretical approach. In this framework, the operative applications will cover both organic and inorganic species. The aim of the course is to make the student able to sketch the electronic structure of the species under study in order to understand and predict their reactivity and electronic properties.

Periodo di Svolgimento/Time Schedule:
February 2020

Prova di accertamento/Final test: Discussion of the potential applications of course learnings towards student's research interests

SSD: CHIM/03

TITOLO DEL CORSO/COURSE TITLE: Orbital Interactions in Chemistry: Hands on

DOCENTE: Prof. Tulika Gupta (Banaras Hindu University)

DOCENTE PROPONENTE: Prof. Federico Totti

ABSTRACT: The course will give the basics to perform simple calculations on ab initio packages of programs on inorganic complexes. The course includes the building and running of inputs. Theoretical aspects learned at the course Orbital Interactions in Chemistry will be exploited to rationalize the computed electronic structure. At request, organic systems will be also considered.

Periodo di Svolgimento/Time Schedule:
8/6/2020-13/7/2020

Prova di accertamento/Final test: Building, running of one input and interpretation of the results.

SSD: CHIM/04-CHIM/06

TITOLO DEL CORSO/COURSE TITLE: Design and synthesis of polymers for biological applications

DOCENTE: Dr.ssa Camilla Parmeggiani/Dr. Daniele Martella

ABSTRACT: Polymeric materials play a key role in many biological applications from substrate for cell cultures to drug delivery. The course will focus on different aspects of polymer chemistry to be properly designed to fit requirements of tissue engineering. Starting from the different polymer classes used for the scope (e.g hydrogels or liquid crystalline polymers), several manufacturing techniques will be presented demonstrating how to modulate the polymer-cell interactions and to create complex 3D scaffolds. Examples of smart materials, whose shape or wettability can be selectively addressed by external stimuli, will be shown for the preparation of dynamic cell scaffold or artificial muscles.

Periodo di Svolgimento/Time Schedule:
3 February 2020 (10:00 -12:00)
5 February 2020 (10:00 -12:00)
10 February 2020 (10:00 -12:00)
12 February 2020 (10:00 -12:00)

Prova di accertamento/Final test: Critical review and discussion of a scientific paper focusing on topics covered in the course

SSD: CHIM/06

TITOLO DEL CORSO/COURSE TITLE: Organocatalysis and photocatalysis: principles and recent synthetic applications

DOCENTE: Prof. Daniele Leonori (University of Manchester)

DOCENTE PROPONENTE: Prof.ssa Franca M. Cordero

ABSTRACT: Organocatalysis and photocatalysis have made remarkable progress in modern chemical synthesis.
Organocatalysts are small organic molecules that catalyse organic transformations by regulating the chemical reactivity of the substrates. Photocatalysts absorb visible light to induce their photoexcited states which can activate unreactive substrates via electron or energy transfer mechanisms.
Moreover, in the last few years, several achievements have been obtained using the combination of photocatalysis and organocatalysis. In this lessons fundamentals and recent developments of these techniques will be discussed.

Periodo di Svolgimento/Time Schedule:
February-March 2020

Prova di accertamento/Final test: Written test